

# ANNOTATED LIST OF FISHES COLLECTED IN THE VICINITY OF GREENWOOD, MISS., WITH DESCRIPTIONS OF THREE NEW SPECIES



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## INTRODUCTION

The collection of fishes upon which the present report is based was made mostly during the summer of 1925 by the junior author within a radius of about 8 miles of Greenwood, Miss., while engaged in an investigation relative to the use of fish for con-

trolling mosquito breeding.<sup>1</sup> It is believed that the species inhabiting the smaller, quiet waters of the vicinity (that is, the potential mosquito-breeding areas) are, with few exceptions, represented in the collection. However, time did not permit extensive collecting in the larger lakes. The Mississippi River was not visited and little collecting was accomplished in the near-by Yazoo, Yalobusha, and Tallahatchie Rivers. Pelucia and Big Sandy Creeks are the only fast-flowing streams visited, and, as explained elsewhere, collections from these streams were made only in their lower courses, lying within the flat delta region. Although a somewhat different fauna was met in the lower sections of these creeks, it seems highly probable that their upper stretches are populated by a number of typical creek species, which, of course, do not occur in the collection.

The most favorable collecting areas for a majority of the species were furnished by the many free-flowing artesian wells, near which ponds of fair size, swales, or sloughs usually are found. The waters frequently support an abundant plant growth, well known to be necessary as a direct source of food and even more so as an indirect source. Due to the heaviness of the soil, ponds are common along highways where excavations have been made in grading; and such waters, when containing a moderate growth of marginal vegetation and when of fair depth, usually support what might appear to be an incredible fish population, not only as to individuals but also as to the number of species. Most of these fish originally gained ingress to these isolated waters through the rather infrequent floods to which the locality is subject. The competition for food doubtless is severe in these ponds, but examinations of ingested materials show a difference in feeding habits among the species which would reduce such competition to a minimum.

These ponds or lakes support an abundance of minute crustaceans, copepods, in particular, furnishing an appreciable component of the diet of several species of fish. A decided preference for fry and minnows is evident among a considerable proportion of the local species, notably the crappies, and in such instances the top minnow *Gambusia* is extensively preyed upon, no doubt because of its abundance and comparatively unwary disposition. Upon final analysis, however, the basis of the diet of the great majority of the fish collected consists of the water boatman, *Corixa*, and to a less extent of the larvæ of the midge.

The water boatman is a rather inconspicuous little insect that gains its name from its manner of progress along the surface, the long swimming legs giving it the appearance of a boat propelled by oars. The adult is somewhat oval in form, 5 or 6 millimeters long, with mottled, brownish back and deep red eyes. The eggs are deposited under water, where they are attached to plant stems (Howard, 1912, pp. 273 and 274).

The next most important source of food is the minute, wormlike larvæ of the midge fly. The adult midge resembles the mosquito superficially, and, like the mosquito, deposits its eggs upon the surface of the water. The immature midges are about 6 to 7 millimeters in length, segmented, with wedge-shaped head, and translucent in color with conspicuous dark eye spots. The larvæ are present in the

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<sup>1</sup> The authors wish to extend their thanks for laboratory facilities and numerous other conveniences to Dr. M. A. Barber, Dr. C. P. Coogle, and W. H. W. Komp, officers of the United States Public Health Service, all engaged at Greenwood, Miss., in researches concerning malaria during the period when the collections upon which the present list is based were made.

quiet waters in considerable abundance, and their dwelling habits apparently make them an easy prey of the fish.

Several distinct types of habitats are represented clearly by various ponds, and while a few species are present virtually always some show a marked adaptive preference, several species being found in single localities only.

The collecting was accomplished mostly with nets; four seines, varying in length from 12 to 300 feet, were found useful, while a dipnet was employed in small ponds and marshes. The greatest depth at which any collection was made did not exceed 6 or 8 feet.

### DESCRIPTION OF THE COLLECTING PLACES

To obviate repetition in describing the environment of each species separately, the following brief descriptions of the various waters visited are appended. The place or places of collection are shown under each species in the list, and by referring to these descriptions the characteristics of the habitat may be ascertained.

#### BORROW PITS, ITTA BENA ROAD

Several roadside excavations about 6 miles southwest of Greenwood, near the Itta Bena Road, are of sufficient size to be classed as medium-sized ponds. The surrounding terrain is low, consisting of reclaimed swamp land, which drains into these pools, making them dependent largely upon the local rainfall. A fairly equable water temperature prevailed, however, due to moderate depth and the shade afforded by the surrounding forest.

The substratum is of the characteristic gray clay known as "gumbo." A feature that deserves particular notice, from the standpoint of its fish-cultural value, is the presence of the primrose willow *Jussiaea diffusa*, which covered not less than half the surface of the water at the time the collections were made and apparently was a noteworthy asset for game fish. In two of the ponds, which have a maximum depth of only 4 feet and an area of about one-eighth of an acre, other species also abounded. The smaller ponds of this group had been overfished with improvised nets, and their value as habitats could not be determined.

Some of these waters were much less overgrown with *Jussiaea* than others, and it was quite evident that those having the closer growth were comparatively clear, which, no doubt, is due to the obstructive effect the plants have upon the waves.

#### BORROW PIT AT MONEY

This large pond was distinctly muddy and perennials were entirely absent, the steep clay banks being 3 or 4 feet high, with an occasional shrub at the water's edge. It was excavated some years ago, but perennials were unable to establish themselves on account of the character of the margins. Pasture lands surrounded it, and shade was entirely lacking. The pond was 200 feet long, 30 feet wide, and 5 feet deep through the center at the time the collections were made.

## BORROW PIT AT WAKELAND

This pond is near the railway, about 6 miles north of Greenwood and 1 mile south of Wakeland, and it is less than one-fourth the extent of the one described in the preceding section. The water is shaded during part of the day by a high railway embankment along one side and several small trees on the opposite shore. The water was moderately muddy, and perennials were almost entirely absent. Of special interest are the myriads of small shrimps (*Palæmonetes exilipes*) that were present and apparently found conditions favorable. Fish also were numerous, and 12 species were taken here, which was a larger number than occurred in other ponds of similar size.

## BORROW PITS, GRENADA ROAD

This series of borrow pits had existed only about 2 years, and the vegetation was not plentiful in consequence. Several species of fish had become fairly well established, but as the maximum depth found in these ponds at the end of the dry season was only 2 feet, and as little shade is afforded, it is obvious that they would prove suitable for only a limited number of species.

## SLOUGH AT BROWNING

An unusually large, free-flowing well at Browning, 4 miles east of Greenwood, forms a narrow slough over 100 yards in extent. The banks are high and wooded, and the water is 10 feet in depth in places, and, being clear and cool, it forms a favorable habitat in some essentials. The banks are too steep and shaded, however, to permit of any but a sparse growth of the usual aquatic plants, with the result that fish are present in rather limited numbers.

## SLOUGH AT MONEY

This slough crosses the highway about 8 miles north of Greenwood and just north of Money. During seasons of high water it is connected with the near-by Tallahatchie River, but when visited it had become isolated. It occupies an old stream bed and was nearly 150 yards in length, with a maximum depth of approximately 4 feet at the time it was visited. The water was turbid and warm, and a cypress growth was present throughout half its length, leaving the remainder unshaded. While it would appear favorable to the growth of perennials, this type of vegetation (except for a narrow marginal stand of coarse grass, *Paspalum distichum*), was lacking and relatively few fish were present.

## SLOUGH NEAR GREENWOOD

This slough is situated near the Memphis Road, 2 miles west of Greenwood, and as it is comparatively wide and shallow it might well be designated a pond. A near-by well flows into a slight hollow, forming this pond of less than 100 yards in length, 50 feet in width, and 18 inches deep through the center. There is a swale or marsh (equaling it in extent) at each end of this slough but they are of such a depth that *Gambusia* only are able to negotiate them. Large trees shade the water at intervals; but for the most part a profusion of marginal plants grows out to a depth of  $\frac{1}{2}$  foot,

forming an excellent habitat for several forms of animal life, particularly for the larval mosquitoes. The soil in this section exceeds the average in fertility and it supports a well-settled rural community. For this reason the pond is overfished. Large numbers of *Gambusia* are present, however, and it is probable that under less disturbed conditions a plentiful stock of the larger species also would be found there.

#### HADLEY OR ALLEN LAKE

Near the Grenada Road, at a distance of about 4 miles northeast of Greenwood, is situated one of the characteristic lakes of the Delta region. It has the appearance of a lagoon, being encircled by a tall cypress growth, which extends into the water to a depth of 4 or 5 feet, and as a dense shade is afforded, small marginal plants are virtually absent. This lake doubtless occupies an old river bed. It is about 1 mile long, 200 feet wide, and of moderate depth, with water, when visited, of medium turbidity.

Seines can not be used in waters of this type, as the cypress, upon completing its growth and falling into the water, apparently undergoes decay very slowly, causing the floor of the lake to be covered to such an extent that to use even small seines is out of the question. The result is that the fish have acquired an unusual degree of protection. Collecting was accomplished with copper sulphate, which was applied to a shallow pool, which had become separated because of a lower water level, at one end of the lake, and from the sample thus obtained it was quite evident that large fish abound in this lake.

#### ROEBUCK LAKE

Roebuck Lake occupies an old stream bed. It has a length of about 9 miles and an average width of 300 feet, giving it much the appearance of a river. Its maximum depth is about 12 feet, becoming quite shallow toward the ends, however. A scattered cypress growth is present along perhaps two-thirds of the shore line, the remainder being bordered by meadow lands. Fish of marketable size are present in quantities. One set with a 300-foot seine commonly yielded 200 pounds of edible fish. Other forms of life, particularly turtles, also abound.

Collections were made at two localities in Roebuck Lake, first along the shore at the foot of a meadow near the town of Itta Bena and next near one extremity of the lake, some  $2\frac{1}{2}$  miles southeast of Itta Bena. This latter section is surrounded by cypress trees, but the width is such that a considerable unobstructed area is available in the center, where seining is practicable, the water being only waist deep. Several collections in both of these places showed that the fish were much more plentiful in the deeper section, where the banks were largely clear of timbers. The buffalo-fish and the gar were the only species found in the timber-bordered section, while a considerable variety was present where more favorable conditions existed.

#### PELUCIA CREEK

The delta region terminates rather abruptly about 6 miles east of Greenwood, where a rapid incline marks the beginning of the uplands. Pelucia Creek, at a point near the Carrollton Road quite close to the foot of this incline, was visited. With an ordinary flow, this stream is 30 feet wide and about knee deep. It is subject to

floods, however, which raise the water to as high as 8 feet and widen the stream proportionately; and as its bed is of coarse sand, it has become eroded to such an extent that at ordinary times the water flows in a relatively thin sheet, in consequence of which it becomes very warm and, no doubt, very well aerated also.

The stream was muddy when visited. It is unshaded, except at rare intervals when it approaches the banks. The current in the straight stretches is too swift to be inhabited by many fish, but at fairly frequent intervals, where bends occur or where a tree lies in the stream, an eddy may be formed; and in such places fish usually were present, probably lying in wait for food brought down by the current. Perennials are almost entirely absent along the banks of this stream, and none were found growing directly in the water.

#### MISCELLANEOUS COLLECTING PLACES

In addition to the foregoing, a number of other places were visited but are not deemed of sufficient importance to be taken up separately, either for the reason that they do not represent types different from those already described or because collecting in them was not practicable with the means at hand.

#### 1. *Polyodon spathula* (Walbaum)

##### SPOON-BILL CAT; PADDLE FISH

*Squalus spathula* Walbaum, *Artedi Piscium*, 1792, p. 522.

The unusual and even grotesque appearance of this strange fish is such that when once seen it is easily remembered, as it differs widely from all other fresh-water species. It resembles the sharks in several particulars and was classed with these forms by an early writer. This resemblance is due to the absence of scales, the unequally developed caudal, the high dorsal fin, and perhaps, also, to the form and position of the mouth, which superficially simulates that of the shark. Its most distinguishing feature, however, is the extended spatulate snout, which is approximately one-third of the length of the entire fish and is one-fourth as broad as it is long in specimens about 370 millimeters in length. It decreases in proportionate length with age.

The paddle fish occupies a separate category from the other fish composing this collection, as this primitive form does not develop the bony skeleton; but instead, the supporting structures are of cartilage.

Although of considerable commercial value locally during the winter, the paddle fish is not taken frequently during the remainder of the year, and only four apparently landlocked fish were obtained—three from a slough at Money and one from a lagoon near Lake McIntire. These approximated 680 millimeters (27 inches) in total length.

The condition of the gonads of these paddle fish (taken in early July) showed the sex elements to be far from mature. Virtually no information is available concerning its spawning habits. The smallest paddle fish recorded (as far as known to the authors) had attained a length of over 4 inches.

Examination of four stomachs indicates that only minute, free-swimming animal life, with little vegetation, had been ingested; and as sand and mud were entirely absent, it is probable that the paddle fish makes good use of its highly developed gills in straining this material from the water as it swims about; and it is presumable that the produced snout has its principal use as a sensory organ of value in determining the immediate presence of food, as it is traversed by two well-developed nerve tracts, one on each side of the heavy central cartilage, and its entire surface is sprinkled with sensory pits. The form of this organ is such that it would be well adapted to stirring over the detritus. The small eyes, unless of unusual power, are of slight use in locating the minute creatures fed upon, as most of them are almost transparent and in the muddy waters sometimes frequented by the paddle fish would be virtually invisible. Although it is an awkward fish and might appear poorly equipped to compete with other forms, it is essentially a specialist, in that it makes use of the animal plankton, which is largely neglected by the other mature species

of this section, with the exception of the large-mouthed buffalo fish, the jack shad, and the round sunfish, which approach the paddle fish in their feeding habits. It seems certain that little difficulty is experienced in obtaining this plankton material, as all of the stomachs examined were well filled, although one of these fish was taken in a lagoon near Lake McIntire, which supported an unusually dense fish population.

In the limited number of stomachs examined copepods constituted the basis of the diet; and although the larvæ and pupæ of the midge, *Coretha*, had been taken in quantities, they are present during only a comparatively short period, of course.

## 2. *Lepisosteus osseus* (Linnæus)

LONG-NOSED GAR; BILL-FISH; SHELL GAR; SPIKE-BILL GAR

*Esox osseus* Linnæus, Syst. Nat., Ed. X, 1758, p. 313.

Only large individuals of this species were taken. Two skins, from fish 890 and 1,180 millimeters ( $35\frac{1}{2}$  and  $47\frac{1}{4}$  inches) long, were preserved and no stomach examinations were made.

The long-nosed gar was not met often, although it may frequent the deeper waters of the rivers and thus have escaped notice. It seems probable, however, that it is primarily a still-water fish and that it is not abundant locally. As its common name implies, this form is characterized by a prolonged beak; and as it is said to frequent submerged brush piles, this specialized organ may be used as "forceps" in obtaining its prey.

With the exception of the produced snout, this gar is very much like the other two species in shape and color. The dorsal surface of the head is plain olivaceous with two fine median dark lines, beginning just posterior to the nostrils and terminating just anterior to the eyes. When measured at a distance of one-third of its length from the tip, the width of the beak is contained from 16 to 18 times in the distance from its tip to the eye. There are from 16 to 24 fulcra in a single row on the anterior edge of the first dorsal ray. The 62 scales in the longitudinal series conform too closely to the number present in the other gars to serve as a distinguishing character.

This species was taken only in Roebuck Lake, where specimens 4 feet in length are quite common and which, according to published accounts, is about the maximum size attained.

## 3. *Lepisosteus platostomus* Rafinesque

SHORT-NOSED GAR; DUCK-BILL GAR; "ALLIGATOR GAR"

*Lepisosteus platostomus* Rafinesque, Ichthyologia Ohiensis, 1820, p. 72.

Fifteen specimens of this gar, ranging in length from 320 to 630 millimeters (13 to 25 inches), were preserved, measured, and examined as to spawning condition and stomach contents. This is the smallest of the gars, as it is reported to reach a length of only 2 to 3 feet.

Of the three species collected, the "short-nosed" gar was by far the most numerous, and it apparently frequents both rivers and lakes. The rather swift, muddy rivers, however, offer the most favorable environment, for here this species was found to exceed greatly all other fish in the numbers present. Being a comparatively sluggish fish, it is netted easily; but this would not account for the relative frequency with which it was taken in the rapid river currents.

In the vicinity of Greenwood (and probably over a wider section) the short-nosed species is known as the "alligator gar." *L. tristachus*, however, is much more generally designated as the alligator gar in literature, and this name is more appropriate for the last-mentioned species because of the very large size attained.

With reference to the length and width of snout, the short-nosed gar is intermediate between the long-nosed species (*L. osseus*) and the alligator gar (*L. tristachus*). The width of the beak, measured just posterior to the fleshy tip, is contained from 6 to 7 times in the total length of the snout.

The heads of the other species of gars are almost plain olivaceous, whereas the short-nosed gar sometimes bears about 9 transverse, dark gray bands, which may be quite distinct on the olivaceous ground color. One specimen has six of these bands between the tip of the snout and the eyes and three between the eyes and the nape. Dorsally, this gar is gray to olivaceous, becoming lighter ventrally, the lower surface being white. The dorsal, caudal, and ventral fins usually are

pale straw color and frequently bear several distinct dusky spots. With reference to the number of fulcra on the dorsal fin, this species again is intermediate, bearing from 8 to 14 of these modified scales in a single row along the anterior edge of the first ray of the dorsal. The rows of scales on the sides in all three species are too close to serve as distinguishing characters.

Except for the head, the gars bear a fairly close resemblance to each other. The long, cylindrical body is incased in an armor of heavy, platelike scales, which, no doubt, afford effectual protection from almost all of their natural enemies. The gars are utilized as food by some of the negroes. The roe of this fish, however, is said to be poisonous.

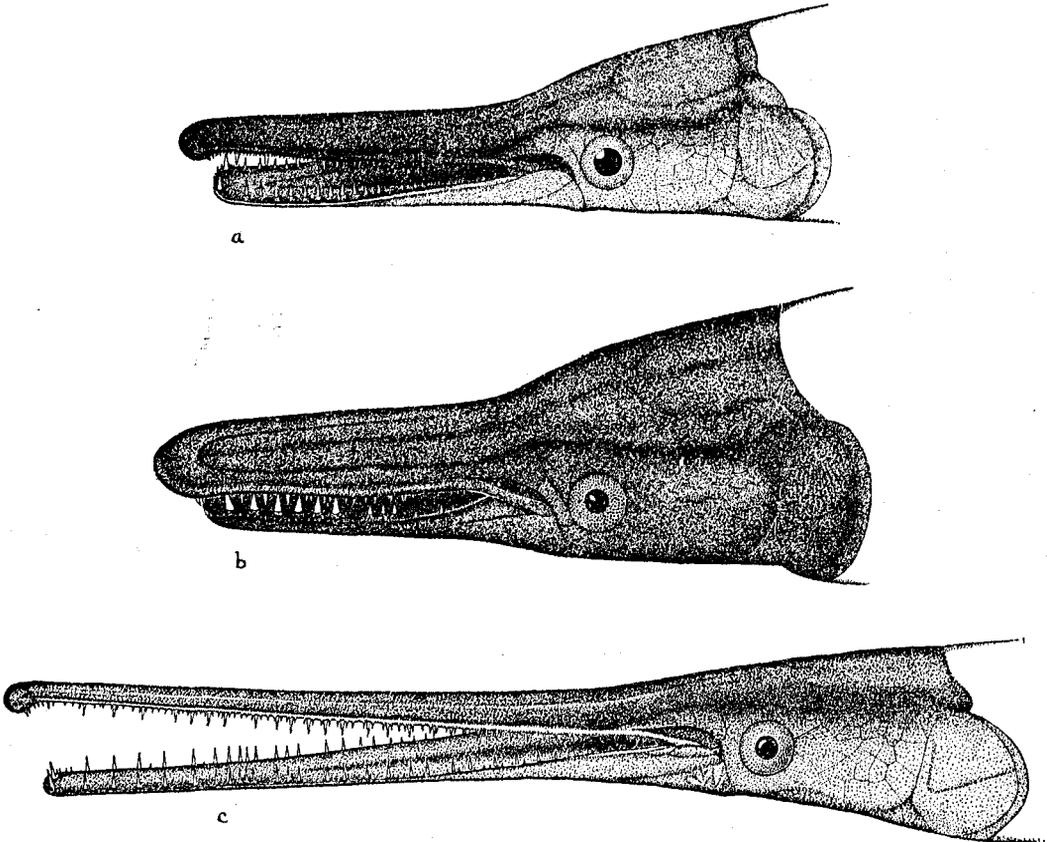


FIG. 1.—Heads of the gars. *a*, *Lepisosteus platostomus*; *b*, *L. tristoechus*; *c*, *L. osseus*. From specimens taken at Greenwood, Miss., in 1925

The short-nosed gar appears to have an extended spawning period, as mature eggs were found in fish taken from late June to late September. The ovary of a 630-millimeter (25 inches) fish contained approximately 6,300 ripe eggs, which averaged 2 millimeters in diameter.

Beetle fragments composed the bulk of the contents of 15 stomachs examined. The small shrimp (*Palæmonetes exilipes*) was utilized somewhat and small fish only rarely. The ingested material apparently undergoes rather thorough mastication before reaching the short, thin-walled digestive tract.

Its distribution is general throughout this section, frequenting rivers, lakes, and ponds; but the rivers apparently afford the most favorable conditions.

4. *Lepisosteus tristoechus* (Bloch and Schneider)

## ALLIGATOR GAR; GREAT GAR

*Esox tristoechus* Bloch and Schneider, Syst. Ichthy., 1801, p. 395.

A single small specimen, 675 millimeters (27 inches) in length, was taken, and it seems probable that this gar is uncommon in the vicinity of Greenwood. The specimen was shown to a local fisherman of experience, who stated that he had not previously seen a gar like it. The short-nosed gar (*L. platystomus*) is known locally as the alligator gar.

This gar is distinguished readily from the short-nosed form by its shorter and wider beak. The width of the organ (measured just posterior to the fleshy tip) is contained 4.2 times in the distance from the tip of the beak to the eye. The body, also, is deeper and broader than in the other species, and it has the appearance of being a more formidable fish. According to published accounts, this species reaches a length of 20 feet. The heavy jaws, with teeth reduced in numbers but considerably enlarged and more or less pear-shaped, probably are especially adapted to rapacious feeding habits, enabling the fish to utilize larger forms than do the other species. The digestive tract in all of the gars is very short and thin-walled, and the indications are that the food undergoes relatively thorough mastication before it reaches the stomach. The remains of a fair-sized fish, with an appreciable amount of vegetable material, were present in the only stomach examined. The single alligator gar in the collection was taken on September 21, 1925, near the southeast end of Roebuck Lake.

5. *Amia calva* Linnæus

## "GRINNEL"; GRINDLE; DOGFISH; BOWFIN

*Amia calva* Linnæus, Syst. Nat., ed. 12, 1766, p. 500.

The grindle has the unusual distinction of being the only surviving species of an entire order and family of fishes now chiefly represented by numerous fossils. Its tenure of life after removal from water is remarkable, and in this respect it was found to exceed even the gar. Fourteen specimens, ranging from 170 to 770 millimeters ( $6\frac{3}{8}$  to  $30\frac{1}{2}$  inches) in length, were preserved and examined for foods consumed.

The grindle is essentially a compact fish, with powerful jaws, the throat being protected by a gular plate, an osseous lamina between the lower jaws. The grindle frequents virtually all of the lakes and ponds of the region, and it seems to prefer relatively warm waters. It is esteemed by the negroes locally as a table fish and is considerably sought for this purpose.

This fish spawns in the spring and not only guards the eggs during incubation but also protects the young during the early stages. Examinations of the gonads of 16 fish taken during the summer and fall showed them to be in an early stage of development.

An examination of the intestinal contents of several specimens indicated the grindle to be a light feeder; and, being rather sluggish, it seems probable that it consumes less than a game fish of equal size. Although its general appearance suggests a voracious appetite, fish of fair size, or up to 450 millimeters ( $17\frac{3}{4}$  inches), were found to have utilized mostly insects ordinarily found near the surface, among which the water boatmen (*Corixa*), dragon-fly nymphs, and the whirligig beetle were the most frequent. The small shrimp (*Palæmonetes exilipes*) also appears to be taken frequently, and an appreciable amount of vegetation usually was present with the other material. The grindle attains a considerably greater length, however, than 450 millimeters, and the larger fish probably require a more substantial diet. One specimen of 770 millimeters ( $30\frac{1}{2}$  inches) had swallowed a fish about 8 inches in length. The 14 grindles collected were taken in a borrow pit and slough at Money, in Hadley or Allen Lake, and in a lagoon near Lake McIntire.

6. *Dorosoma cepedianum* (Le Sueur)

JACK SHAD; SKIP JACK; "SCISSOR-BELLY SHAD"; GIZZARD SHAD

*Megalops cepedina* Le Sueur, Journ., Ac. Nat. Sci., Phila., I, 1818, p. 361.

Although of slight value, directly, as a food fish, the jack shad, through utilizing the fine plankton largely neglected by most other fish, furnishes the carnivorous species a valuable source of food. The specialized gill rakers (which, on the first arch, numbered close to 350 in a specimen 95 millimeters in standard length) enable it to utilize this microscopic material, which undergoes the first stage of digestion in the thick-walled gizzardlike stomach. The intestine slightly exceeds the fish in length. Copepods predominated in the seven stomachs examined, with an appreciable quantity of *Daphnia* and fine vegetation also present.

Gravid females were taken in June. One of these, 315 millimeters in length, contained approximately 50,000 eggs, being more prolific, probably, than any other fish of the region.

The jack shad is represented in the collection by 12 specimens, ranging in length from 58 to 315 millimeters ( $2\frac{2}{6}$  to  $12\frac{3}{6}$  inches), collected in a borrow pit along the Itta Bena Road and in a borrow pit at Wakeland.

Genus *ICTIOBUS* Rafinesque

The following key is introduced to show the distinguishing characters noticed by the authors, who experienced some difficulty in identifying the species.

## KEY TO THE SPECIES

- a. Mouth large, oblique; upper lip on or above level of lower margin of eye; lips thin and nearly smooth; gill rakers long and numerous, 38 to 55 on first arch-----*cyprinella*, p. 114
- aa. Mouth smaller, less oblique to inferior; upper lip much below level of the lower margin of eye; lips thickened, more or less striate; gill rakers shorter and only about half as numerous as in the preceding.
- b. Back notably elevated and strongly compressed; depth of body (in Greenwood specimens) 2.4 to 2.5 in length; vertical distance from origin of dorsal to a straight line running through the center of eye to lateral line on base of caudal equal to or greater than head; ventral outline from chin to ventrals nearly straight; anterior rays of dorsal strongly elevated, the longest one equal to length of head; mouth small, inferior, more strongly protractile downward than forward-----*bubalus*, p. 115
- bb. Back less strongly elevated and less strongly compressed; depth of body (in Greenwood specimens) 2.75 to 3.15 in length; vertical distance from origin of dorsal to a straight line running through center of eye to lateral line on base of caudal, notably shorter than head; ventral outline more strongly curved; anterior rays of dorsal shorter, the longest one 1.25 to 1.55 in head; mouth a little larger, oblique, protractile forward rather than downward-----*urus*, p. 115

7. *Ictiobus cyprinella* (Cuvier and Valenciennes)

BIG-MOUTH BUFFALO; RED-MOUTH BUFFALO; "GOURD-HEAD BUFFALO"

*Sclerogmathus cyprinella* Cuvier and Valenciennes, Hist. Nat. Polss., XVII, 1844, p. 477.

This common buffalo fish is represented in the collection by 16 specimens ranging in length from 200 to 485 millimeters (8 to  $19\frac{1}{6}$  inches). Much variation in depth among specimens exists. For example, in two fish, each 250 millimeters in standard length, the depth varies from 82 to 97 millimeters. This fish differs from the other species in the large oblique mouth, thin lips, and weak pharyngeal teeth, characters usually given in keys; also in the much more numerous and more slender gill rakers, the first arch supporting 38 to 55 rakers, exclusive of the fleshy ridges on the lower part of the arch, whereas in the other species this arch has only about half that many. Forbes and Richardson (1908, p. 70), however, state that *I. cyprinella* has 75 gill rakers on the first arch. This appears to show either a wide variation (if the identifications be correct) among individuals or a difference in the number of gill rakers with age. The five specimens from Greenwood examined with

respect to this character ranged from 225 to 400 millimeters in length, and the smallest of these had 55 and the largest 51 gill rakers, whereas a specimen 305 millimeters long had only 38. These counts do not suggest a variation with age but a rather large difference among individuals.

With reference to the size attained locally, the gourd-head buffalo is intermediate of the other two species of buffalo fish recorded in this report and was less frequently taken than either of them. It is quite common, however, and is a valuable food fish.

An examination of 25 stomachs of all three species shows an appreciable difference in the feeding habits, and their divergence in form may be correlated with this factor.

The gourd-head buffalo, according to six stomachs examined, depends upon the minute plankton crustaceans and, to a less extent, the free-swimming insect larvæ for the basis of its diet, in this respect closely resembling the spoonbill catfish. These two fish were the only ones that had utilized the almost transparent midge larvæ *Corethra*. Vegetation was used sparingly. Forbes and Richardson (1908, p. 70) found about a third of the stomach contents in 17 specimens examined to consist of vegetable matter and the other two-thirds consisted of aquatic insects and Entomostraca.

The large mouth and well-developed gill rakers (which are fully twice as numerous as in the two related species herein considered) seem well adapted to obtaining this type of food. A muscular expansion of the stomach forms a sort of gizzard, and the intestine is relatively long, being almost three times the length of the fish. These structures would suggest a vegetable diet greater than has been shown by the stomachs examined.

The reproductive organs in six specimens taken during the summer and fall were all in a collapsed condition. The spawning period is reported to occur during the early spring (Forbes and Richardson, 1908, p. 70).

A deep slough at Browning was well stocked with this species, and it was collected in a borrow pit and in a slough at Money, in Hadley or Allen Lake, Roebuck Lake, and in a lagoon near Lake McIntire.

### 8. *Ictiobus bubalus* (Rafinesque)

#### SMALL-MOUTH BUFFALO; RAZOR-BACK BUFFALO; QUILL-BACK BUFFALO

*Ambloplites bubalus* Rafinesque, Journal Physique, 1818, p. 421.

This species is represented in the collection by 22 specimens, ranging in length from 160 to 370 millimeters ( $6\frac{1}{4}$  to  $14\frac{1}{2}$  inches). It is characterized chiefly by the high, compressed back and long, falcate dorsal fin, the last-mentioned character giving origin to the name "Quill-back." Other characters are shown in the key.

This is the smallest and probably the least important, economically, of the three buffalo fish collected in the vicinity of Greenwood. Although this species is reported in some sections of its range to reach a weight somewhat less than 40 pounds, the largest one taken locally during the summer weighed only 3 pounds, and the average was much smaller.

Disintegrating, darkened plant fragments were estimated to constitute fully 80 per cent of the diet, with the remainder usually consisting of copepods and midge larvæ in 8 stomachs examined. The inferior mouth and straightened ventral line characterize it as a bottom feeder. It has a less effective straining apparatus than *I. cyprinella*, as its gill rakers are not quite as long and only about half as numerous. The intestine approximates two and one-half times the length of the body, placing this fish intermediate in this respect of the other two buffalo fish collected locally.

The spawning season in the south is said to occur during March and April. The specimens examined, all of which were taken during the summer, had passed the spawning period. This species was collected in a slough at Browning, Roebuck Lake, Mossy Lake, and in a slough near Siden.

### 9. *Ictiobus urus* (Agassiz)

#### MONGREL BUFFALO; "ROOTER"; "LINER"

*Carpiodes urus* Agassiz, Amer. Journ. Sci. Arts, XVII, 1854, p. 355.

This species is represented by 15 specimens, ranging from 225 to 420 millimeters (9 to  $16\frac{1}{2}$  inches) in length. It is characterized principally by the low, rounded back, convex ventral outline the moderate mouth (which is protractile, forward and downward), and the less strongly falcate dorsal fin as compared with the other species. These differences are recognized by local fishermen.

From an economic point of view, the liner is probably in advance of the other two buffalo fish locally, as its average size is greater and it is more abundant.

While its diet, as shown by nine specimens examined, resembles somewhat that of the gourd-head, in that it had eaten a moderate amount of the plankton crustaceans, it also had made use of comparatively coarse insects, particularly the abundant water boatman (*Corixa*) and midge larvæ. Possibly in consequence of this coarse diet, the stomach is more muscular, is better developed than in *I. cyprinella*, and is about twice the size of that of *I. bubalus*. In comparison with the other two, its intestine is the shortest, being slightly over twice the length of the body, and the intestinal walls are notably thicker.

Nine specimens taken during the summer were examined for the condition of the gonads; the spawning season evidently was past. In Illinois this species is reported to spawn in the spring (Forbes and Richardson, 1908, p. 72).

The liner was collected in borrow pits on the Itta Bena Road in Hadley or Allen Lake, in a lagoon near Lake McIntire, and in a brickyard pond in Greenwood.

### 10. *Carpiodes difformis* Cope

#### RIVER CARP

*Carpiodes difformis* Cope, Proc., Am. Phil. Soc., Phila., 1870, p. 480.

We refer 32 specimens, ranging from 35 to 160 millimeters ( $1\frac{3}{8}$  to  $6\frac{1}{8}$  inches) in length, somewhat doubtfully to this species. The body appears to be unusually slender, the depth (in nine specimens 75 to 160 millimeters long) varying from 2.9 to 3.15 in length, and the back is little

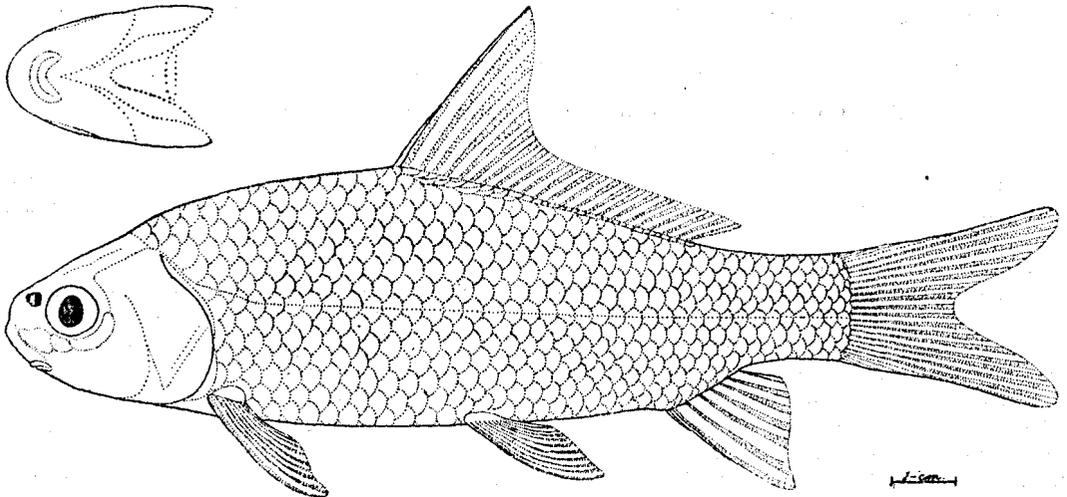


FIG. 2.—*Carpiodes difformis*, from a specimen from Greenwood, Miss., taken in Pelucia Creek, June 23, 1925

elevated. The interorbital space is contained 2.55 to 2.8 in head; snout 3.45 to 3.9; tip of lower lip under posterior nostril; scales in lateral line, 36 or 37; dorsal fin notably elevated in front, the longest ray in the large specimens reaching middle of base of dorsal and fully equal to length of head; the number of rays vary from 25 to 27.

The branchial arches, with their numerous long gill rakers (about 45), almost encircle a bulbous enlargement at the cranial base, constituting an extremely effectual straining apparatus. The relative value of this unique strainer, or selective apparatus, may be gauged by comparing this species with *Hybognathus nuchalis*, in which the bulbous enlargement is wanting. Although both species ingest the same type of material, the river carp appears to be able to obtain a greater proportion of organic material with the ingested mud. From an examination of the intestinal contents of four specimens it would appear that over 90 per cent of the ingested material consists of sand

and mud, only a minor quantity of organic material being present. The entire intestine, which is slightly over three times the length of the fish, remains virtually the same size throughout, and as it is usually well filled it is probable that food is taken continuously. The inferior mouth of this river carp also indicates it to be a bottom feeder, and as it was found only in the eddies of Pelucia Creek (a rapid stream, where organic matter is rather scarce) it seems probable that large quantities have to be taken in order to provide sufficient nutritive material.

The species was collected on June 19 and 23 and September 16, and only in Pelucia Creek. The condition of the sexual organs of the fish would indicate that spawning takes place early in the spring.

### 11. *Hybognathus nuchalis* Agassiz

#### SILVERY MINNOW

*Hybognathus nuchalis* Agassiz, Amer. Journ. Sci. Arts, XIX, 1855, p. 224.

The collection contains 55 specimens, ranging from 25 to 110 millimeters ( $2\frac{1}{8}$  to  $4\frac{3}{8}$  inches) in length. This fish, like the river carp, ingests quantities of sand and mud with a comparatively small proportion of fine organic material. This minnow, however, possesses an inferior straining apparatus, but, on the other hand, its intestine is proportionately about twice the length of that of the river carp or six times the length of the fish; and as the tracts (in specimens examined) always were filled throughout, the silvery minnow appears to be capable of little selection of the material it ingests in feeding on the bottom, and comparatively large quantities are taken.

Spawning occurs in this region principally in June and July. A fish 80 millimeters long contained 480 apparently mature eggs approximating  $\frac{1}{2}$  millimeter in diameter. This is primarily a stream-dwelling form, and 46 of a total of 55 specimens were taken in Pelucia Creek; the others were from borrow pits at Money, Browning, and near the Grenada Road.

### 12. *Notemigonus crysoleucas* (Mitchill)

#### GOLDEN SHINER; ROACH

*Cyprinus crysoleucas* Mitchill, Rept., Fishes, New York, 1814, p. 23.

This shiner is represented in the collection by 87 specimens, ranging in length from 57 to 150 millimeters ( $2\frac{1}{4}$  to 6 inches). No larger representatives of the species were seen. The specimens are quite uniform in color and structure. Even the depth between young and adults (the young usually being more slender) does not vary greatly, as in 13 specimens, ranging in length from 58 to 145 millimeters, the variation of the depth in length of body is only 3.4 to 3.95. The scale formula in the same specimens is 10 or 11-48 to 56-4 or 5; dorsal 9 to 11; anal 13 to 16.

This species, which locally appears to inhabit only the quiet waters, has a markedly varied diet. Many individuals had fed entirely upon vegetation, consisting of darkened, disintegrating plant fragments, filamentous algæ, or seeds, while others had taken appreciable quantities of minute crustaceans, principally Cladocera. The digestive tract usually is well filled, and it is probable that the shiner has little difficulty in obtaining its food. This tract slightly exceeds the length of the fish. Its walls are thin and the stomachic dilation is hardly perceptible.

The spawning period is considerably extended. Forbes and Richardson (1908, p. 128) give May as the principal spawning time. Some of the Greenwood specimens, taken in July and August, contain well-developed roe. The ovary of a fish 100 millimeters in length, taken August 17, contained approximately 1,500 nearly matured eggs.

The shiner is a favorite bait for bass in the South. It was taken only in the following small bodies of waters: Borrow pits, Itta Bena Road; borrow pit at Money; borrow pits, Grenada Road; slough at Browning; and slough near Greenwood.

### 13. *Notropis atherinoides* Rafinesque

#### SHINER

*Notropis atherinoides* Rafinesque, Amer. Month. Mag., 1818, p. 204.

We refer to this species with much doubt, one specimen, 36 millimeters ( $1\frac{1}{2}$  inches) long, taken in a slough near Money. The specimen does not agree with current descriptions of *atherinoides*, in that the dorsal fin has 11 rays instead of 8, and it is inserted only slightly behind the base of the

ventrals. Its origin is about equidistant from tip of snout and base of caudal. The specimen has only a faint lateral band.

#### 14. *Notropis cooglei* n. sp.

##### SPOT-TAILED MINNOW

The authors are aware of the complexity of the group of fishes assigned to the genus *Notropis* and of the inadequate definitions of many of the species. Under the circumstances, they naturally hesitate to add another name. It has been impossible, however, after examining available literature and making comparisons in the National Museum with supposedly related forms, to identify the specimens at hand with any known species. As no other course appears to be open, we propose for them a new name and describe the specimens as follows:

*Diagnosis.*—Body deep, compressed, depth 3.55 to 4.05 in standard length; snout pointed, as long as eye; mouth terminal, oblique; pharyngeal teeth 4-4 or 1, 4-4, 1, hooked; dorsal rays 9

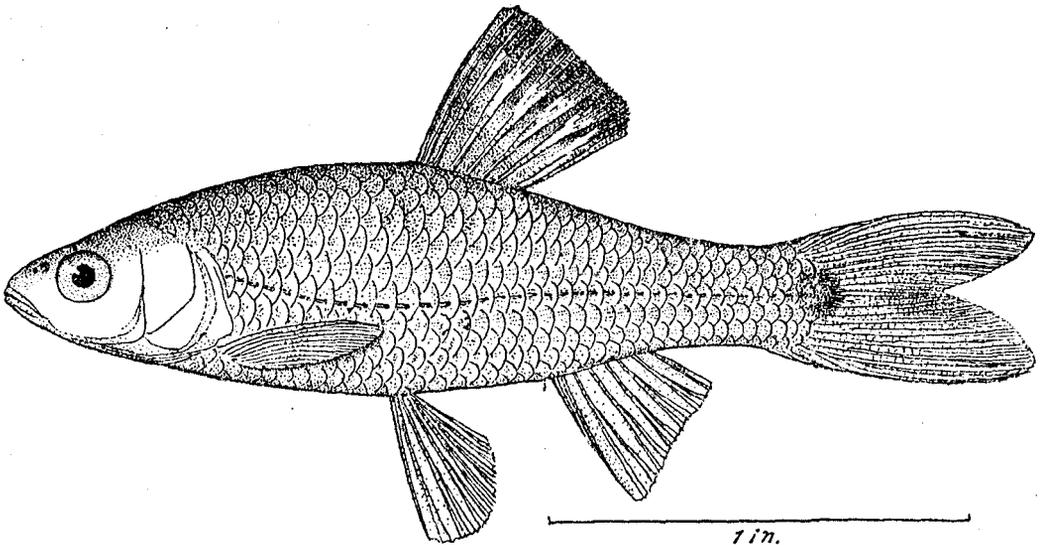


FIG. 3.—*Notropis cooglei* n. sp. From a paratype

or 10; origin of fin a little behind ventrals; anal rays 10 or 11; scale formula 6 or 7-37 to 42-4 or 5, from 15 to 18 in advance of dorsal; exposed part of scales on sides notably deeper than long; lateral line strongly decurved; an evident dark caudal spot present.

*Description of type.*—Body deep, compressed; the back elevated, the depth 3.65 in length; head 4.15; snout short, 3.33 in head; eye 3.75; mouth rather large, oblique; maxillary not quite reaching front of eye, 3.75 in head; interorbital convex, 2.5; scales notably deeper than long on sides, 38 in lateral line, 7 between lateral line and origin of dorsal, 4 between lateral line and origin of anal; lateral line complete, decurved, far below axis of body; origin of dorsal a little behind insertion of ventrals or midway between tip of snout and base of caudal, margin of fin nearly straight, the anterior rays not reaching the tips of the posterior ones when deflexed; caudal fin deeply forked, both lobes pointed and of equal length; origin of anal at vertical from end of dorsal base and a little nearer base of caudal than margin of opercle, outer margin of fin slightly concave; ventral fins reaching slightly beyond origin of anal; pectorals pointed, 1.15 in head.

*Color.*—Bluish silvery above, becoming pale silvery underneath; sides posteriorly with a diffuse plumbeous band; an evident black caudal spot present; dorsal fin pale, with numerous, dusky punctulations, giving the fin a generally smoky appearance, particularly distally; caudal fin pale, with somewhat fewer dusky punctulations than the dorsal; the other fins yellowish in life almost white in spirits.

*Variability.*—The specimens at hand show a rather high degree of uniformity of the various proportional measurements taken, as well as in fin and scale counts. In 17 specimens, varying in

standard length from 36 to 65 millimeters, the following range in measurements and counts resulted: Head, 3.9 to 4.25 in standard length; depth, 3.55 to 4.05; eye, 2.9 to 4 in head; snout, 3.1 to 4; interorbital, 2.4 to 3.35; maxillary, 3.2 to 4; depth of caudal peduncle, 2 to 2.55; pectoral fin, 1.1 to 1.45; scales, 6 or 7-37 to 42-4 or 5, from 15 to 18 in advance of dorsal; dorsal rays, 9 or 10; anal rays, 10 or 11. Pharyngeal teeth, 4-4, or about equally 1, 4-4, 1 (nine specimens examined for this character). In color, some of the specimens are much darker than others. This may be due, in large part, to the preservative used, as some of the specimens were preserved in alcohol and others in formaldehyde. In general, the latter are lighter in color, but the caudal spot appears darker and more distinct. This spot is not always equally distinct, and in a few rather poorly preserved specimens it is wanting.

*Holotype*.—No. 83379, United States National Museum, standard length 61, total length 76 millimeters, Pelucia Creek, Greenwood, Miss., June 19, 1925.

*Paratypes*.—Thirty-six specimens, 20 to 52 millimeters, obtained with the type; 24 specimens, 20 to 60 millimeters, June 23, 1925; 70 specimens, 20 to 53 millimeters, July 6, 1925; 55 specimens, 29 to 55 millimeters, September 16, 1925, all from Pelucia Creek; 29 specimens, 19 to 65 millimeters, July 6, 1925, Big Sandy Creek, Valley Hill, Miss.

The species is named for Dr. C. P. Coogle, of the United States Public Health Service, to whom the authors are indebted for valuable aid in making the collection upon which the present report is based.

This spot-tailed minnow, according to the contents of 15 stomachs, is primarily insectivorous. A few specimens were found that had taken quantities of sand and mud, but as the intestine is relatively short, scarcely equaling the length of the body, this fish seems unsuited to this type of material. Vegetable material, in the form of algæ, and plant fragments, too, had been taken in moderate quantities. The basis of the diet in the specimens examined, however, consisted of the frequent water-boatman, *Corixa*.

Spawning may take place over an extended period. Gravid fish were collected during July and August. A male, with numerous tubercles on its head, was taken as late as September 16. A full-grown female, 64 millimeters in length, contained approximately 600 mature eggs, and another minnow of 44 millimeters contained less than one-half that number.

### 15. *Semotilus atromaculatus* (Mitchill)

#### CREEK CHUB; HORNED DACE

*Cyprinus atromaculatus* Mitchill, Amer. Month. Mag., II, 1818, p. 324.

This minnow appears to be of infrequent occurrence in this region, as it was taken only once when two small specimens were collected in a slough near Browning. These fish were each 41 millimeters ( $1\frac{3}{8}$  inches) long.

The intestinal tracts in the small specimens collected equaled three-fourths of the total length of the fish. One of the fish had ingested hundreds of minute insect eggs and the other had taken several small insects.

The scarcity of this species may be due to the absence of suitable waters in this locality, for the creek chub is reported to show a distinct preference for creeks, increasing in abundance toward the headwaters of small streams. Due to the flatness of the land, the creeks in the immediate vicinity of Greenwood are rather sluggish, and therefore are not typical of the waters usually frequented.

### 16. *Ictalurus furcatus* (Le Sueur)

#### BLUE CAT; FULTON CAT; MISSISSIPPI RIVER CAT

*Pimelodus furcatus*, Le Sueur, in Cuvier and Valenciennes, Hist. Nat. Poiss., XV, 1840, p. 136.

A single young individual, 195 millimeters long, was taken. This species may be distinguished at once from the related species by the long anal fin, which has 36 rays (in our specimen), and its base is contained 1.05 in the predorsal length. It is evident, also, when comparing other *Ictalurus* of about the same size, that the body is heavier and deeper, the dorsal profile in advance of dorsal is steeper; the eye is smaller, being contained 5.45 times in the head, or 8 times in the predorsal length; the barbels are all shorter and weaker than in other *Ictalurus* of the same size, the maxillary barbel scarcely reaching the gill opening; and the predorsal distance is much shorter than the distance between the dorsal fins.

The specimen at hand had fed on fish, insects, crustaceans (*Daphnia* recognized), and apparently on plants. The single very young individual in the collection was taken in the Tallahatchie River on June 26.

### 17. *Ictalurus punctatus* (Rafinesque)

#### CHANNEL CAT; FIDDLER

*Silurus punctatus* Rafinesque, American Monthly Magazine, 1818, p. 359.

This common species is represented by 11 specimens, ranging in length from 82 to 350 millimeters ( $3\frac{1}{4}$  to 14 inches). It differs from related forms in the narrow head and snout, the prominent bony ridges on the head, and in the slender caudal peduncle. This fish usually has black spots on the sides, which form a ready recognition mark. These marks are wanting in all the specimens from Greenwood, however, except one, and that one is very sparsely flecked.

The channel cat, although known to enter standing and sluggish water occasionally, appears to be fairly well confined in its habitat to streams. One individual at hand was taken in a sluggish slough; all the others were caught in faster running water.

According to Jordan and Evermann (1902, p. 22), the channel cat spawns in April and May in Louisiana. The gonads in the two larger individuals in the present collection, taken July 14 and September 16, were in early stages of development. All the others were too small to have reached sexual maturity.

Four specimens were examined for food. The diet consisted of fish and insect and plant fragments. The specimens were collected in Pelucia Creek, near Browning, and in a slough near Lake McIntire.

### 18. *Ictalurus anguilla* Evermann and Kendall

#### "FORKED-TAIL CAT"; "WILLOW CAT"; "MUD CAT"; EEL CAT

*Ictalurus anguilla* Evermann and Kendall, Bull., U. S. Fish Com., XVII, 1897 (1898), p. 125, pl. 6, fig. 1.

This species is represented in the collection by 19 specimens, ranging in length from 95 to 400 millimeters ( $3\frac{3}{4}$  to 16 inches), all taken in quiet waters.

The specimens from Greenwood differ in one character from the type with which we have compared them, which is constant among our specimens—namely, in the notably more anterior position of the dorsal fin. In the Greenwood specimens the origin of the dorsal is much closer to the tip of the snout than the origin of the adipose, and the distance from tip of snout to the origin of the dorsal is equal to the space between the dorsal fins. In the type the origin of the dorsal is equidistant from the tip of the snout and origin of the adipose, and the distance from the tip of the snout to the origin of the dorsal is shorter than the distance between the dorsal fins. No other differences of importance were noticed. The following proportions and counts are based on nine specimens, ranging in length from 120 to 400 millimeters. Head 3.7 to 4.1 in length to base of caudal; predorsal distance 2.75; greatest width of head 1.75 to 1.9 in predorsal distance; length of snout 2.3 to 2.65 in head; width of snout at base of maxillary barbels 2.2 to 2.45; eye 4 to 7.35; interorbital space 1.75 to 2.3; depth of caudal peduncle 2.55 to 2.7; dorsal spine 1.4 to 1.85; pectoral spine 1.45 to 2.05. Dorsal rays I, 6; anal rays (including rudiments) 26 or 27. The color of the specimens is uniformly dark. A few of them have a crowding of dark punctulations on the side, making dark specks, in that respect resembling the usual color pattern of *punctatus*.

This species is recognized by the low, broad head, very broad snout, low ridges on the head and the deep caudal peduncle (2.55 to 2.7 in head, or 3.8 to 3.9 in predorsal distance, in *anguilla*; 2.8 to 3 in head, 4 to 4.45 in predorsal distance, in *punctatus*).

The gonads of 10 fish taken during the summer and fall were all in an early developmental stage, and it is probable that spawning takes place in the spring, as in related species.

The ingested material found in 10 specimens indicate that this fish is a voracious, carnivorous feeder. The diet varied considerably but was composed largely of insects and fish. The water boatman, *Corixa*, appeared frequently, with immature midges, dragon flies, and minute crustaceans in appreciable quantities. The willow cat also ingests considerable vegetation. An unusual diversity is apparent in the feeding habits of this fish, which is most evident in specimens caught in lakes and ponds, where a variety of foods exists from which to choose. One willow cat, 365

millimeters long, taken in Roebuck Lake, had ingested quantities of a water weed and insects in about equal amounts; the insects present were midge larvæ and dragon-fly nymphs. A second specimen, 152 millimeters long, from the same lake, had swallowed 20 crappies, each approximately 1 inch long; and a third willow cat, of 345 millimeters, also from Roebuck Lake, had taken thousands of water boatmen, *Corixa*. The largest specimen collected, having a length of 600 millimeters, had swallowed a member of its own species approximately 6 inches in length.

The willow cat was collected at the following localities: Borrow pit, Itta Bena Road; borrow pit at Wakeland; and Roebuck Lake. The borrow pits on the Itta Bena Road yielded more of this species than the other localities. The species appears to be an inhabitant of standing or sluggish water only, in which it is common at Greenwood.

### 19. *Ameiurus nebulosus* (Le Sueur)

COMMON BULLHEAD; BROWN BULLHEAD; SPECKLED BULLHEAD; "POLLY-WOG CAT" (YOUNG)

*Pimelodus nebulosus* Le Sueur, Memoir., Mus. Hist. Nat., V, 1819, p. 149.

A few dozen specimens, ranging from 85 to 350 millimeters ( $3\frac{1}{2}$  to 14 inches) in length, were preserved. The fish vary considerably in shade; that is, some are dark bluish to blackish, whereas others are light olivaceous, but the mottled form (*marmoratus*) was not taken. The range in anal rays (including rudiments) in 18 specimens is as follows: One with 20, one with 22, two with 21, eight with 23, five with 24, and one with 25.

This catfish was taken somewhat less frequently than the willow cat. Locally, it shows a preference for ponds well supplied with vegetation, and in no instance was it found in running water.

This common catfish, as shown by published accounts, has a varied diet. It is generally described as being carnivorous. Forbes and Richardson (1908, p. 188), however, found specimens that had fed on "distillery slops and accidental rubbish." Ten specimens examined in the Greenwood collection contained mainly darkened, disintegrating plant fragments, which apparently had been collected on the floor of the quiet waters in which the specimens were taken. Only one, the largest,  $13\frac{3}{4}$  inches long, had taken an appreciable amount of animal matter, and this specimen contained portions of a good-sized fish.

While this fish is known to reproduce in the spring, it is probable that the spawning period may be considerably extended, as a fish 235 millimeters long, taken August 27, was approaching maturity, the ovary containing approximately 3,000 eggs, which averaged 1.25 millimeters in diameter.

With the exception of the borrow pit near the Itta Bena Road, where a large brood of young fish was noticed, the bullhead was found only in small numbers at the following localities: Slough near Greenwood, borrow pit at Money, borrow pits on Grenanda Road, Hadley or Allen Lake, and a brickyard pond at Greenwood.

### 20. *Ameiurus natalis* (Le Sueur)

YELLOW CAT; YELLOW BULLHEAD

*Pimelodus natalis* Le Sueur, Memoir., Mus. Hist. Nat., V, 1819, p. 154.

A single small specimen, 55 millimeters long, was secured in Hadley Lake. This species is recognized principally by the long anal fin, which has 27 rays in the specimen at hand. Comparing this fish with specimens of *nebulosus* of the same size, the head appears to be somewhat broader and the tail fin is distinctly rounded in *natalis*, whereas it is emarginate in *nebulosus*. The other common species, *melas*, to which these species are related, was not obtained.

### 21. *Leptops olivaris* (Rafinesque)

"YELLOW CAT"; MUD CAT; GOUJON

*Silurus olivaris* Rafinesque, American Monthly Magazine, 1818, p. 355.

Only three small individuals, respectively 66, 75, and 305 millimeters ( $2\frac{3}{8}$ , 3, and  $12\frac{1}{8}$  inches) in length, were taken. This species reaches a very large size, individuals weighing 75 and even 100 pounds having been reported. It is recognized by the extremely low, broad head; very small eye, placed high on the head; projecting lower jaw; and the short anal fin, which is composed of only 12 to 15 (15 in each specimen at hand) rays.

In the vicinity of Greenwood the yellow cat appears to be a stream fish and was found only in the rapid waters of Big Sandy Creek near the Valley Hill station. It may inhabit the near-by rivers, but, as stated elsewhere, the extent of collecting accomplished in these waters was negligible. Big Sandy Creek closely resembles Pelucia Creek and, although the latter was seined upon numerous occasions, the yellow catfish was taken nowhere except in Big Sandy Creek.

Stomach examinations of the three specimens in the collection showed it to be a decidedly carnivorous form. The largest specimen had swallowed one of its own species, approximately 25 millimeters long. The other two had fed upon small fish and insect larvæ.

In Illinois (Forbes and Richardson, 1908, p. 194), the yellow cat spawns during April and early May. The local spawning period could not be determined from the small specimens available.

## 22. *Schilbeodes gyrinus* (Mitchill)

### TADPOLE CAT

*Silurus gyrinus* Mitchill, American Monthly Magazine, 1818, p. 322.

Two specimens, 52 and 57 millimeters (2 to 2½ inches) in length, were taken in company with the willow cat in a borrow pit situated on the Itta Bena Road, which was largely overgrown with the primrose willow. The species was not seen elsewhere. In this species the adipose fin is continuous with the caudal, without a definite notch, the pectoral spines have no bony hooks, and the jaws are equal.

## 23. *Fundulus notatus* (Rafinesque)

### TOP MINNOW; TOP-WATER MINNOW; BLACK-BANDED MINNOW

*Semotilus notatus* Rafinesque, Ichthyologia Ohiensis, 1820, p. 86.

This minnow, widely distributed through the central plains region and the Gulf drainage, is represented in the present collection by 10 specimens, ranging in length from 36 to 80 millimeters (1½ to 3½ inches). In the adult the males are distinguished from the females by the much more numerous black specks above the dark lateral band. The female generally has only one or two rows of dark specks above the lateral band, whereas the male has several rows and is speckled everywhere except on the back in advance of dorsal. In the female the lateral band is uniformly black and definitely defined, both above and below. In the male the lateral band is crossed by short black bars, at least anteriorly, which are a little greater in length than the width of the band and extend slightly below it and sometimes also slightly above it, making the outline of the lateral band irregular.

This is the most conspicuous minnow of our inland waters, apparently always present at the surface, where it may be seen from a distance, and in swimming it leaves ripples on the water, resembling in these respects the cuatro-ojo, or four-eye (*Anableps dowii*), of Central America. In the South Atlantic drainage this species is replaced by the related *F. nottii*, which appears to be identical in its habits.

In its feeding habits this minnow, according to eight stomachs examined, appears to be omnivorous, taking appreciable quantities of vegetation but relying principally upon terrestrial insects of comparatively large size, which probably are taken as they fall into the water. The stomachic dilation is slight and the intestine approaches one-half the total length of the fish.

The ovary of a minnow 70 millimeters long, taken June 30, 1925, contained 40 ripe eggs approximately 1.25 millimeters in diameter and an equal number of eggs only one-half as large, indicating that spawning may take place two or more times during one season. Repeated spawning does not appear to be unusual in this group of fishes.

The 10 specimens at hand were collected at the following localities: Slough at Browning, Hadley or Allen Lake, Pelucia Creek, a pond at Valley Hill railway station, and Big Sandy Creek.

## 24. *Fundulus kompi* n. sp.

The collection contains 31 specimens of *Fundulus*, ranging in length from 36 to 63 millimeters (1½ to 2½ inches), which we are unable to identify with any known species, and therefore we propose for them a new name and describe them as follows:

*Diagnosis.*—Body moderately deep, compressed, depth 3.8 to 4.45 in standard length; head broad, depressed; interorbital broad, 2.15 to 2.5 in head; origin of dorsal a little behind origin of anal, the fin with 8 or 9 rays; anal with 10 or 11 rays; scales 32 to 36 in lateral series, 16 to 18 oblique rows between upper angle of gill opening and origin of dorsal; females in alcohol plain grayish; males with 6 or 7 dark crossbars.

*Description of type, male.*—Body moderately deep, compressed; outline straight over head, convex from nape to dorsal; head depressed, flat above, head 3.8 in standard length; depth 4; snout broad, its length 3.75 in head; eye 3; interorbital 2.15; caudal peduncle 1.55; mouth nearly terminal, the lower lip only slightly in advance of the upper; teeth in the jaws in bands, the outer series enlarged; scales firm, 33 in a lateral series, 18 oblique series between upper angle of gill opening and origin of dorsal, enlarged scales extending forward on snout; dorsal fin with 8 rays, its origin over anterior third of anal, equidistant from middle of eye and tip of caudal; caudal fin round; anal fin somewhat larger than the dorsal, with 10 rays, its origin a little nearer end of caudal than tip of snout; ventral fins rather small, scarcely reaching vent, inserted equidistant from tip of snout and base of caudal; pectoral fins reaching base of ventrals, 1.5 in head.

*Color.*—Grayish-brown above, becoming pale underneath; a prominent dark median stripe on back in advance of dorsal; sides with six dark crossbars and with a faint dark spot above base of pectoral, suggesting a seventh bar; no dark blotch below eye; dorsal fin slightly dusky, with blackish

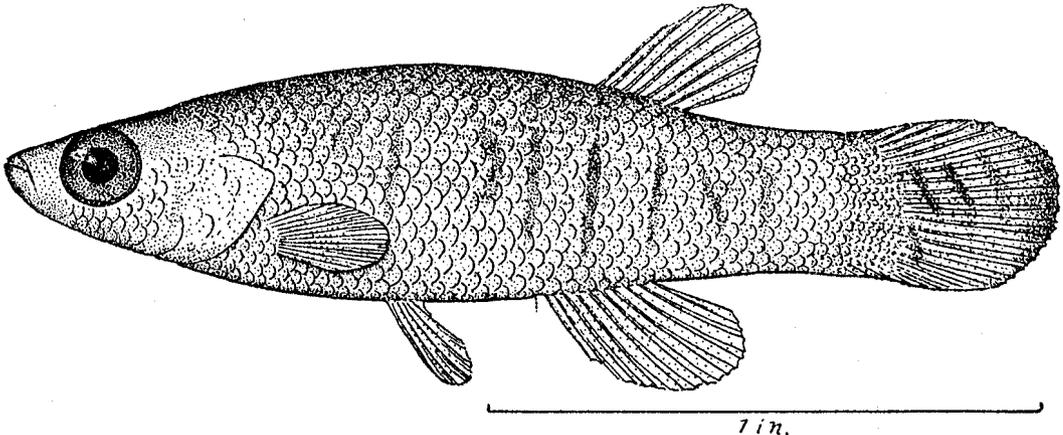


FIG. 4.—*Fundulus kompi* n. sp. From a paratype (male)

spots on posterior interradial membranes; caudal fin pale, with small dark spots on basal two-thirds; anal fin pale, with some dusky punctulations and indications of a few dark spots on posterior interradial membranes; ventrals and pectorals colorless.

*Variability.*—The smaller specimens (females) appear to be more elongate and less strongly compressed than the adults and they look rather strikingly, in general appearance and color, like female *Gambusia*. The dorsal and anal fins are lower in females than in males. The color in life of a male (paratype) 40 millimeters in length was olivaceous above, pale blue-green on sides, and cream underneath. The crossbars were green. The fins were colorless, except for reddish spots on the posterior interradial membranes of the dorsal and anal and on nearly the entire caudal. In alcohol the females are plain color, being brownish gray above and pale underneath. A distinct median dark line extends from the nape to the dorsal fin. The fins are all plain unspotted.

*Holotype.*—No. 88380, United States National Museum, standard length 39, total length 50 millimeters, borrow pit along the Greenwood-Itta Bena Road, June 12, 1925.

*Paratypes.*—Seven specimens, from type locality, taken on May 22 and October 2, 1925, and 23 specimens from the same pond, collected during August, 1927.

The relationship of these specimens appears to be with the coastwise swamp species, *F. chrysotus*, from which they differ (as determined by a comparison of specimens from Greenwood and from Florida (*F. chrysotus*)) in the more anterior position of the dorsal fin, as compared with the distance from the eye. The fins generally are longer, and the color of both males and females is different.

The species is named for W. H. W. Komp, of the United States Public Health Service, who was engaged at Greenwood, Miss., in research pertaining to malaria when the present collections were made. Mr. Komp rendered much valuable aid in the conduct of the work and the authors take pleasure in naming this fish for him.

This small fish was taken only in a borrow pit near the Itta Bena Road, where it was very plentiful, frequenting a growth of primrose willow, *Jussiza diffusa*, along the shallow margins, with *Gambusia*, whose dwelling and feeding habits it appears to simulate. It is a more active fish than *Gambusia*, however, and better suited to survive where game fish are present in numbers, which was the condition in this pond. A determination of its food was not made from stomach examinations; when confined in an aquarium, mosquito larvæ were taken readily shortly after the fish was captured. The tract is short and thick-walled, approximating three-fourths of the length of the fish. A gravid female, 63 millimeters long, was taken in June, its ovary containing 150 eggs.

### 25. *Gambusia patruelis* (Baird and Girard)

#### TOP MINNOW

*Heterandria patruelis* Baird and Girard, Proc., Acad. Nat. Sci., Phila., VI, 1854, p. 390.

We follow Hubbs (1926a, p. 38) in using the specific name *patruelis*, replacing the name *affinis*, long used for this species. Mr. Hubbs produced evidence indicating that *affinis* apparently belongs to another species, which seems to be of limited distribution, being known, to date, only from the San Antonio-Guadalupe River system of Texas; whereas the present species ranges from southern Indiana and Illinois southward to the Gulf coast. Due to its wide distribution, abundance, and top-feeding habits, this minnow is a factor of importance in the control of mosquito breeding and is widely employed in the South for this purpose. It is extremely prolific and swarms in virtually all permanent waters where conditions favor mosquito production.

Its diet is varied, and besides insects and other animals of suitable size it has been found to utilize vegetation and even the young of its own species. There is only a slight stomachic dilation, and the relative length of the intestinal tract apparently varies with the sex. In six adult male specimens, 28 to 31 millimeters long, it averaged 42 per cent of the total length of the fish; whereas in six females, 35 to 39 millimeters long, it averaged 57 per cent of the total length.

The eggs of *Gambusia* develop within the female, and the young are brought forth at a relatively well-developed, active stage and having an average length of 8 millimeters. The breeding season commences in the early spring and continues through August and, to a limited extent, into September. The size of the brood in general varies with that of the female parent. For example, a 29-millimeter fish produced 5 young, whereas a 50-millimeter fish produced 77 young. Broods ranging upward of 200 fish have been reported for the related species *G. holbrooki*.

It has been shown by Barney and Anson (1921, p. 58) and Hildebrand (1927, p. 392) that a great seasonal difference takes place in the sex ratio of adult *Gambusia*; that is, the males are proportionately much fewer in midsummer than during the rest of the year. The difference, according to rather extensive statistics recently produced by Hildebrand, vary from 1 male to 2.54 females in June to 1 male to 11.3 females in August. Hildebrand also produced extensive evidence in corroboration of Geiser's (1924, p. 198) contention that a 1 to 1 sex ratio exists in young *Gambusia*. The question then arises, what becomes of the males afterwards? A definite answer can not be given, but Geiser (1924, p. 201) and Hildebrand (1927, p. 400) have produced evidence showing that the males are less resistant than females to adverse condition, and it seems probable that the males constitute the weaker sex. It appears to be of interest to mention, in this connection, that among a lot of 184 adult *Gambusia* taken from a slough at Browning on August 6, which were heavily infested with a parasite forming conspicuous external cysts, the ratio was 1 male to 25 females. Possibly the scarcity of males was due to their low resistance to the parasite. Although the males were few in this slough, the minnows were numerous, notwithstanding the fact that it was a favorite place for collecting *Gambusia* for bait.

*Gambusia* were present in all local waters, with one exception, this being a borrow pit at Money, where the crappie is abundant and protection in the form of marginal vegetation is almost absent. The most favorable habitat was in a section of a brook that passes through a hog yard situated near the city. Several hundred *Gambusia* were collected. The largest males were 33 millimeters ( $1\frac{1}{2}$  inches) long, and the largest females were 50 millimeters (2 inches) in length. The male is not distinguishable externally from the female until it attains a length of about 20 millimeters, at which size the anal fin usually has assumed its characteristic form—that is, the anterior rays have become

elongated and bear bony hooks at the tips. It then forms an organ used in conveying the sperms from the male to the female.

The species of this genus are highly useful for the reduction of mosquito breeding. A large degree of natural control is provided by these fish throughout the South, east of the Rocky Mountains, where their distribution is quite general. In a number of the Southern States efforts have been made to distribute *Gambusia* to waters it had not reached through natural channels. *Gambusia* has been introduced in several States and many foreign countries to aid in abating the mosquito nuisance. In some localities it has not survived because the winters were too cold; in others it met enemies it could not combat. Several importations, as in Italy, Spain, and the Hawaiian Islands, have proved very beneficial. For an account of a rather exhaustive study of the effectiveness of *Gambusia* as an eradicator of mosquito larvæ, the reader is referred to Public Health Bulletin No. 153, United States Public Health Service (1925, Washington). *Gambusia holbrooki* was used in the studies reported upon in this bulletin. Somewhat similar studies were carried on later with *Gambusia patruelis*, which gave similar results. It may be stated that in general the degree of mosquito control provided depends partly upon the number of fish present but to a greater extent upon the amount of protection against fish which the mosquito larvæ receive from the presence of plants and flottage.

## 26. *Aphredoderus sayanus* (Gilliams)

### PIRATE PERCH

*Scolopsis sayanus* Gilliams, Jour., Acad. Nat. Sci., Phila., IV, 1824, p. 81.

This fish probably is not abundant locally, as only nine specimens, ranging in length from 48 to 87 millimeters (2 to 3½ inches), were taken. The pirate perch is of much interest to the naturalist who has not yet been successful in explaining satisfactorily the unusual phenomenon of the change in position of the vent that takes place with age. For the vent is "normally" placed in the young; that is, it is posterior to the ventral fins. It gradually moves forward, however, as the fish grows, and finally occupies a place on the isthmus between the gill covers. Forbes and Richardson (1908, p. 231), in discussing this subject, state that a comparison of food of specimens of various ages gave no hint for the reason of this extraordinary step in development.

The rather unusual development of the pelvic girdle, which arches into the center of the abdominal cavity, thereby reducing the space somewhat, may have some correlation with the anterior position of the vent in the adult. In adult perch the pelvic arch is traversed by the small intestine, which enters the arch posteriorly and proceeds anteriorly to the jugular vent. The small intestine is comparatively short, averaging only about 25 per cent of the total length of the fish, and by traversing the girdle in its anterior progress along the floor of the abdominal cavity it occupies a space that could not be used more economically by another organ. An examination of nine stomachs showed that immature insects, principally midge larvæ, had been taken by the pirate perch, with virtually no other food in evidence. Forbes and Richardson (1908, p. 230), in examining 19 stomachs, also found most of the food to consist of insects and insect larvæ, and only two of the specimens had eaten fish.

Two females taken at Greenwood on September 30, 1925, were approaching the spawning period; the larger of these, measuring 87 millimeters in total length, contained approximately 1,100 eggs. Forbes and Richardson (1908, p. 231) found spawning fish at Meredosia, Ill., in May. This appears to suggest a long spawning period. The nine specimens at hand were taken from borrow pits on the Itta Bena Road and the Grenada Road.

## 27. *Boleosoma camurum* Forbes

*Boleosoma camurum* Forbes, Bull., Ill. Lab. Nat. Hist., II, 1878, p. 40.

This small darter is represented by 14 specimens, ranging in length from 32 to 43 millimeters (1¼ to 1¾ inches). The species is characterized by the incomplete lateral line, which extends only under the spinous dorsal, and by the distantly placed dorsal fins, the tips of the spines of the first dorsal scarcely reaching the origin of the second dorsal when deflexed. The cheeks, opercles, and chest are all fully scaled in the specimens at hand.

Insects only, consisting chiefly of midge larvæ were found in the eight stomachs examined. This fish was taken in a borrow pit at Craigsides, where it was common, and one specimen was secured in a sluggish stream at Browning.

### 28. *Copelandellus fusiformis* (Girard)

*Boleosoma fusiformis* Girard, Proc., Bost. Soc. Nat. Hist., 1854, p. 41.

This species does not appear to be very common locally, as only four specimens, ranging in length from 28 to 40 millimeters ( $1\frac{1}{8}$  to  $1\frac{1}{2}$  inches), were taken. In this species the lateral line is incomplete, ending under the base of the second dorsal or somewhat in advance of that point, and it is notably curved upward, following the outline of the back. The premaxillaries are not protractile. The head in the specimens in hand is contained 3.7 to 4 in the standard length; depth 5.15 to 5.35; D. IX-9 to 11; A. I, 6 to 7; scales 50 to 55.

Only fragments of insects were found in the three stomachs examined. The specimens were taken in a borrow pit near Craigsides and in a very sluggish stream at Browning.

### Genus POMOXIS Rafinesque; Crappies

#### KEY TO THE SPECIES

- a. Eye of moderate size, 3.1 to 5.4 in head, equal to or shorter than snout; gill rakers of moderate length, shorter than snout.
  - b. Body usually not very deep, the depth 2.4 to 2.7 in standard length; dorsal profile deeply concave over eyes, more or less S-shaped in outline; mouth moderately oblique, a straight line from posterior margin of maxillary and perpendicular with anterior margin of premaxillary usually passing in front of base of dorsal; dorsal spines usually 6, rarely 5, occasionally 7 (among 55 specimens, 1 had 5 spines, 44 had 6, and 10 had 7 spines); sides often with indications of dark crossbars; anal often dusky, but without black spots.....*annularis*, p. 126
  - bb. Body usually deeper, the depth 2.25 to 2.6 in standard length; dorsal profile less deeply concave over eyes, the outline less strongly S-shaped; mouth rather strongly oblique, a straight line from posterior margin of maxillary and perpendicular with anterior margin of premaxillary, usually passing well behind origin of dorsal; dorsal spines usually 7, rarely 6, occasionally 8 (among 43 specimens, 4 had 6 spines, 30 had 7, and 9 had 8 spines); sides usually more profusely spotted with dark, the markings not tending to form crossbars; anal fin usually with dark spots.....*sparoides*, p. 127
- aa. Eye very large, 2.6 to 2.9 in head, distinctly longer than snout; gill rakers long and slender, equal to length of snout; body not very deep, the depth 2.55 to 2.85; dorsal profile scarcely concave over eyes; mouth quite oblique, a straight line from posterior margin of maxillary and perpendicular with anterior margin of premaxillary, passing somewhat posterior to origin of dorsal; dorsal spines 7, occasionally 8 or 9; color plain, the vertical fins usually more or less dusky, without definite dark spots.....*barberi* n. sp., p. 128

### 29. *Pomoxis annularis* Rafinesque

#### WHITE CRAPPIE

*Pomoxis annularis* Rafinesque, Amer. Month. Mag., 1818, p. 41.

The diagnostic characters of this and the related species are shown in the key presented herewith. In separating this species from *sparoides*, any one of the characters mentioned can not always be relied upon, as all of them either overlap or are at times indistinct. A comparison of three or more characters, therefore, often is necessary for positive identification.

Of the two common species of crappie (white and black), this one appears to be the most numerous locally, occurring in a ratio of about two to three. Forbes and Richardson (1908, p. 240) indicate it as having a more southern range than the black crappie, *P. sparoides*. At Greenwood the two species frequently were taken together in the same ponds.

In their feeding habits the two common crappies are very similar, as in this region both appear to subsist largely upon small fish; and in this respect they are a distinct aid to the mosquito, in that their principal food, according to the contents of 51 stomachs examined, consists of the top minnow, *Gambusia*, which in the South is the most effective natural enemy of the mosquito. The fish diet was supplemented largely by the water boatman, *Corixa*, and to a less extent by the shrimp, *Palæmonetes exilipes*. The young white crappie utilized copepods almost exclusively until an approximate total length of 90 millimeters was attained, when a rather definite transfer to the adult diet was noted. The young black crappie, on the other hand, also utilized the minute crustaceans, but was frequently found to have taken fish when it had attained a length of only 70 millimeters. In addition to the copepods, the young crappie had utilized to a much less extent, also, Cladocera and phyllo-pods.

The spawning season at Havana is in May, as indicated by Forbes and Richardson (1908, p. 239). A crappie 135 millimeters long, taken June 16, 1925, contained approximately 1,200 ripe eggs, which, no doubt, is below the average production, as this fish was a comparatively small one.

Ninety-four specimens, ranging in length from 55 to 360 millimeters ( $2\frac{1}{8}$  to  $14\frac{1}{8}$  inches), were preserved. These were collected at three localities: Borrow pit on the Itta Bena Road slough at Money, and borrow pit at Craigsides.

### 30. *Pomoxis sparoides* (Lacépède)

#### BLACK CRAPPIE; CALICO BASS

*Labrus sparoides* Lacépède, Hist. Nat. Poiss., III, 1802, p. 517.

In general, as shown in the key, this species has a deeper body than *annularis*, less deeply concave dorsal profile, more oblique mouth, and in color it generally differs in being more definitely spotted, none of the dark markings being arranged so as to form crossbars, as is often the case in *annularis*, and the spots usually are extended on the anal fin. In *annularis* the interradial membranes of the anal fin frequently are dusky, but this color is not broken up into spots as in *sparoides*.

In this region the black crappie simulates the white crappie in its fish and insect diet, as shown by a comparison of the food contents of 42 stomachs of the former and 51 stomachs of the latter. It thrives, however, when small fish are not available and under these circumstances was found to utilize the plankton crustaceans, including copepods, Cladocera, and ostracods, in lieu of the small fish. The insect component of the diet, which consisted largely of the water boatman, *Corixa*, appeared never to be lacking. The young black crappie apparently subsists almost entirely upon copepods and under normal conditions changes to the adult diet when it approximates 80 millimeters in length. In all three species listed the stomach is large and the length of the intestine is contained about three and one-half times in the total length of the fish.

On account of their frequency and predatory habits, these fish locally are by far the most formidable enemy of the mosquito-destroying minnow, *Gambusia*, which in this region forms the basis for the fish diet of the crappies. In addition to *Gambusia*, small bass, sunfish, and the young of their own kind were found to have been ingested.

In an attempt to determine whether the young crappie was of value as a mosquito-larvæ eradicator, 100 fish, approximating 1 inch in length, were confined to an area of 120 square feet in a borrow pit, and this inclosure was compared with another in which no fish were present. In this instance the results were entirely negative, as the young crappie apparently ignored the numerous larval mosquitoes during the whole course of the experiment, which was conducted over a period of two months.

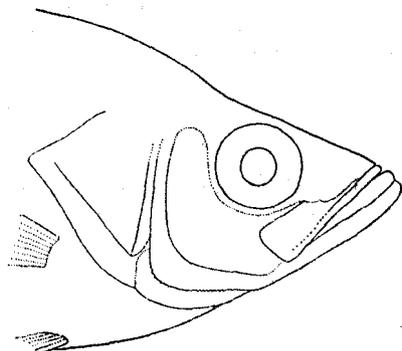


FIG. 5.—Outline of head of *Pomoxis annularis*.  
From a specimen 145 millimeters long

This fish is suited to a variety of habitats, thriving equally as well in muddy water as it does in clear water, being found in large numbers in a borrow pit at Money, where vegetation was almost absent and the water was excessively muddy.

Spawning takes place in May at Havana, Ill. (Forbes and Richardson, 1908, p. 241), and it is probable that the season is about the same at Greenwood.

The 60 specimens preserved range in length from 58 to 290 millimeters ( $2\frac{1}{8}$  to  $11\frac{3}{8}$  inches) and are from the following localities: Borrow pit, Itta Bena Road; borrow pit at Money; slough at Browning; Hadley or Allen Lake; and Roebuck Lake.

### 31. *Pomoxis barberi* n. sp.

#### BIG-EYED CRAPPIE

The collection contains nine specimens of this crappie, ranging in length from 136 to 152 millimeters ( $5\frac{1}{3}$  to 6 inches), which we describe as a new species.

*Diagnosis.*—Body moderately slender for a *Pomoxis*, its depth 2.55 to 2.85 in standard length (2.25 to 2.6 in *sparoides* and 2.4 to 2.7 in *annularis*); dorsal profile scarcely concave over eyes, even less so than in *sparoides*; eye very large, its diameter much greater than distance from tip of lower jaw to eye (this distance about equal to diameter of eye in *annularis* and *sparoides*), 2.6 to 2.9 in head (comparing specimens of equal size, the eye is contained in head 3.15 to 3.55 in *annularis* and 3.1 to 3.4 in *sparoides*); mouth rather strongly oblique, a straight line from posterior margin of maxillary and perpendicular to the anterior margin of premaxillary, passing somewhat posterior to origin of dorsal; gill rakers long and slender,

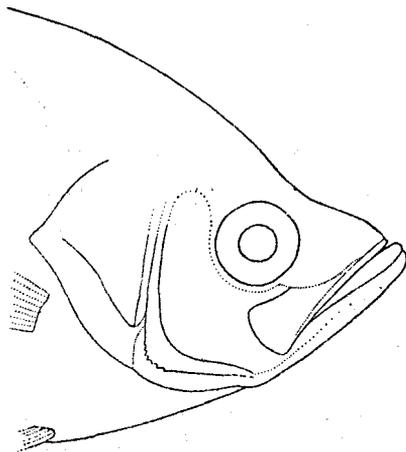


FIG. 6.—Outline of head of *Pomoxis sparoides*.  
From a specimen 140 millimeters long

about equal to length of snout, 15.5 in standard length, as compared with about 18 in related species; dorsal spines usually 7, occasionally 8 or 9; color rather plain, no indications of crossbars, anal fin sometimes more or less dusky, not spotted.

*Description of type.*—Body moderately slender, compressed, outline over eyes scarcely concave; head 2.85 in standard length; depth 2.7; snout short, pointed, 4.75 in head; eye very large, 2.7; interorbital 5.45; caudal peduncle rather long and slender, its depth 2.55 in head; mouth quite oblique; lower jaw projecting, extending into the dorsal profile; maxillary reaching opposite middle of eye, 2.15 in head; a line from posterior margin of maxillary and perpendicular to the anterior margin of the premaxillary passing through base of third dorsal spine; teeth in jaws pointed, in bands; gill rakers long, slender, 21 on lower limb of first arch, the longest ones as long as snout, 5.4 in head or 15.5 in length; scale formula 5-33-13; dorsal fin high, with VIII,15 (more usually VII,15 or 16 in paratypes), the spine slender, increasing in length posteriorly, the longest one 1.4 in head; the origin of fin about the length of the snout nearer tip of lower jaw than base of caudal; caudal fin only slightly forked; anal base nearly as long as that of dorsal, the fin with VI,18 rays, the spines graduated as in the dorsal, the last spine 1.57 in head, origin of fin under base of fifth dorsal spine and about equidistant from tip of lower jaw and base of caudal; ventral fins inserted under base of pectorals, the longest rays reaching opposite base of last anal spine; pectoral fins moderately long, 1.35 in head.

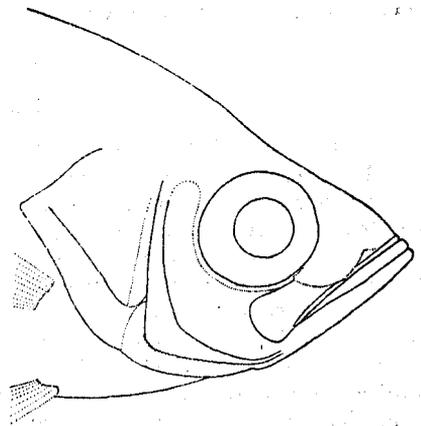


FIG. 7.—Outline of head of *Pomoxis barberi*.  
From a paratype 143 millimeters long

*Color*.—In alcohol, plain grayish green above and silvery below. Fins all pale, the dorsal, caudal, and anal with dusky punctulations, these most numerous distally on caudal.

*Variability*.—The specimens, being of nearly uniform size, vary little among themselves. The dorsal spines in the nine specimens at hand vary from 7 to 9—that is, six have 7 spines, two have 8, and one has 9 spines. The anal fin has 6 spines in eight specimens and 7 in the other. In color they vary in the number of dusky punctulations present on the vertical fins, some of the paratypes having the fins much darker than the type. The dark color, however, is not arranged in spots, as in *sparoides*, resembling *annularis* in this respect. Some of the paratypes have indications of pale spots on the caudal fin. Such spots are quite numerous and distinct on the caudal in specimens of about the same size in the related species and often are present, also, on the dorsal and anal fins.

*Holotype*.—No. 88381, United States National Museum, standard length 107, total length 142 millimeters; borrow pit near Money, August 14, 1925.

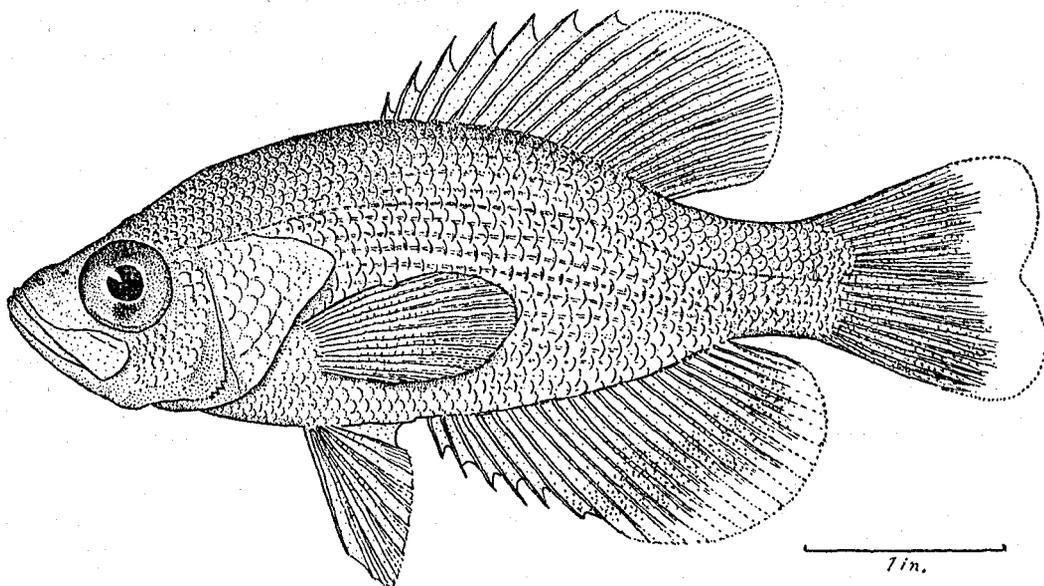


FIG. 8.—*Pomoxis barberi* n. sp. From a paratype

*Paratypes*.—Eight specimens from the type locality, all taken with the holotype.

The species is named for Dr. M. A. Barber, of the United States Public Health Service, who was engaged at Greenwood, Miss., in researches pertaining to malaria during the period when the present collection was made. Doctor Barber allowed the authors the free use of his laboratory and rendered other valuable aid.

This fish was found only in a borrow pit near Money in association with the black crappie, the white crappie being absent in this pond. This borrow pit had a length of about 200 feet, a width of about 30 feet, and the greatest depth of the water when the collection was made was about 5 feet. This pond, owing to its steep banks, the grayish clay soil, wave action, and the almost total absence of vegetation, was distinctly muddy. The golden shiner (*Notemigonus crysoleucas*) was the only other species present.

Four specimens of this species examined for food had fed mainly on copepods, ostracods, and some insects (principally back swimmers). The other species of crappie, when they had attained a length as great as the specimens of this form that were examined, usually had changed definitely to a fish and large insect diet, and the small crustaceans were ignored. Due to the scarcity of other foods, the fish probably continued to feed on the usual diet of the young. In obtaining this small food, they doubtless were aided by the long gill rakers and probably also by the very large eye. In eight specimens of the size of the black crappie, from the same body of

water, the alimentary canal was almost empty, as only a few insects (back swimmers), fragments of insects, and very few copepods and ostracods were found. *Gambusia*, one of the chief foods, locally, of the crappies, was absent in this pond.

### 32. *Chaenobryttus gulosus* (Cuvier and Valenciennes)

#### WARMOUTH BASS; "SPOTTED BREAM"

*Pomotis gulosus* Cuvier and Valenciennes, Hist. Nat. Poiss., III, 1829, p. 498.

This is one of the common sunfishes at Greenwood, being exceeded in abundance only by the bluegill sunfish and by the white and black crappies. Its large mouth, the maxillary reaching past the middle of the eye, and the presence of teeth on the tongue distinguish it from related species occurring locally. In structure, the specimens at hand are fairly uniform, but in color there is much variation, both with age and among individuals of the same size. The young of about 3 inches and less in length have indefinite crossbars and no indications of dark spots on the scales that form longitudinal lines in adults. The dark stripes on the cheeks, usually quite evident and distinctive of the species, occasionally are wanting, and some individuals are much more definitely spotted than others.

The fin rays appear to be remarkably constant, for in 18 specimens examined, the dorsal fin had 10 spines in 15 specimens, 9 in 2 specimens, and 11 in only 1 specimen. The soft rays numbered 10 in all except one specimen, which had 11. In the same specimens the anal fin constantly had 3 spines and 9 or 10 soft rays.

The warmouth bass, although entirely carnivorous, has a notably varied diet, as shown by the contents of 18 stomachs, depending largely upon insects, however. The water boatman, *Corixa*, and whirligig beetles frequently are taken. Crustaceans, including the shrimp *Palæmonetes exilipes*, were next in frequency, with small fish less evident than either of these groups. The intestine approximates one-half the total length of the fish.

The reproductive period appears to be an extended one, as ripe fish were taken through June, July, and August. Sexual maturity seems to be reached at a comparatively small size, as a female only 85 millimeters in length contained well-developed roe. A fish 124 millimeters in total length contained approximately 4,000 nearly mature eggs, and larger individuals probably produce a proportionately larger number of eggs.

The 54 specimens in the collection range from 52 to 178 millimeters (2 to 7 inches) in total length and were collected at the following points: Borrow pit, Itta Bena Road; borrow pits, Grenada Road; slough at Browning; slough near Greenwood; Hadley or Allen Lake; borrow pit at Craigsides; and in a drainage ditch at the Tallahatchie compress.

### 33. *Centrarchus macropterus* (Lacépède)

#### ROUND SUNFISH; "SUN PERCH"

*Labrus macropterus* Lacépède, Hist. Nat. Poiss., III, 1802, p. 447.

This little sunfish is quite unimportant as a food fish and is not very numerous locally. The numerous anal spines and rays (the usual number being VIII, 14), the short, round body, and the dark stripes along the rows of scales serve well to separate it from the other sunfishes.

Among the members of the sunfish family (*Centrarchidæ*) occurring in the present collection, the round sunfish is the best adapted for the utilization of the plankton crustaceans through its increased number of gill rakers. This species and the crappies were the only representatives of the family that made use of the minute crustaceans after the fish had reached the "adult stage," and under normal conditions the mature crappies apparently also ignored this type of food. The following table shows the wide variation in the number and length of the gill rakers that exists among the local representatives of this family.

Species	Number of gill rakers on lower limb of first arch	Per cent of diameter of eye occupied by longest gill rakers
<i>Pomoxis annularis</i> .....	19-22	66
<i>Pomoxis spheroides</i> .....	19-21	48
<i>Pomoxis barberi</i> .....	20-21	53
<i>Centrarchus macropterus</i> .....	25-27	61
<i>Chænobryttus gulosus</i> .....	6- 8	43
<i>Apomotis cyanellus</i> .....	8- 9	45
<i>Lepomis megalotis</i> .....	6	12
<i>Lepomis humilis</i> .....	9-10	30
<i>Lepomis incisor</i> .....	6-10	27
<i>Lepomis heros</i> .....	7	20
<i>Micropterus salmoides</i> .....	6- 7	74

Copepods, according to 10 specimens examined, constitute the principal food sought by the round sunfish; and small insects, including mosquito larvæ, also are taken frequently. Mosquito production probably is appreciably reduced in waters where this fish is numerous. The largest specimen (155 millimeters long) had fed largely upon immature mosquitoes, its stomach containing 20 anopheline and 6 culecine larvæ. This fish, however, was from a borrow pit at Money, where the mosquito-destroying minnow, *Gambusia*, was absent and the crappie was present in numbers sufficient to have reduced considerably the plankton Crustacea. The stomach is large, and the intestine is equal to one-third the total length of the fish.

A fish 120 millimeters in total length, taken June 20, contained approximately 5,600 nearly mature eggs, indicating that spawning probably takes place in the late spring and early summer. Ten specimens, ranging in length from 56 to 155 millimeters ( $2\frac{1}{6}$  to  $6\frac{1}{16}$  inches) were collected at the following localities: Borrow pit at Money; borrow pits on Grenada Road, slough near Greenwood; and borrow pit at Craigsides.

**34. *Apomotis cyanellus* (Rafinesque)**

**GREEN SUNFISH; "BREAM"; "SUN BREAM"**

*Lepomis cyanellus* Rafinesque, Journal Physique, 1819, p. 420.

We follow Hubbs (1926, p. 72) in delimiting this species from *Lepomis*, although we are not convinced of the value of the further generic divisions that Mr. Hubbs has made. The large mouth and the well-developed supplemental maxillary bone in *cyanellus*, however, appear to be sufficiently important to permit of its generic distinction.

Locally, this sunfish is only a little less common than the warmouth. It is recognized by the large mouth (the maxillary reaching nearly or quite opposite the middle of the eye), the well-developed supplemental maxillary bone, and the toothless tongue, and in life it generally has wavy, blue-green lines on the cheeks and opercles.

Forbes and Richardson (1908, p. 250) examined the stomachs of eight specimens and found that more than one-third of the food consisted of fish and the remainder was composed of insects and crawfish. In Athens, Tex., the senior author selected a pond for propagating *Gambusia* to be used in antimosquito work. This small body of water was thought to be virtually free of fish. *Gambusia* did not thrive, however, and when the pond was seined it was found to contain a few green sunfish, which had the appearance of being well fed, and these fish, no doubt, had kept the *Gambusia* from multiplying. With this information at hand, it was rather surprising to find no fish at all among the foods eaten by 32 specimens examined, most of which were collected where small fish were numerous. Midge larvæ constituted the bulk of the food taken by the smaller sunfish; the water boatman *Corixa* occurred frequently in the ingested material of medium-sized fish or those from 30 to 60 millimeters in length; while whirligig beetles and larger beetles were favored by the full-grown fish. The stomach is large and the intestine is equal to one-half the total length of the fish.

The spawning season evidently is an extended one, as ripe or nearly ripe fish were taken in June, July, August, and September. A female 116 millimeters in length contained approximately 4,900 nearly mature eggs.

This species is represented in the collection by 43 specimens, ranging in length from 32 to 130 millimeters ( $1\frac{1}{8}$  to  $5\frac{1}{8}$  inches). These were collected at the following localities: Borrow pit, Itta Bena Road; slough at Browning; slough near Greenwood; Pelucia Creek; and a borrow pit at Craigsides.

### 35. *Lepomis incisor* (Cuvier and Valenciennes)

BLUE-GILL; "BLUE-NOSED BREAM"; "SHINER BREAM"

*Pomotis incisor* Cuvier and Valenciennes, Hist. Nat. Poiss., VII, 1831, p. 466.

Many specimens of this fish were preserved. A very large degree of variation with respect to the depth and the contour of the body, the length of the opercular flap, and color is evident among the specimens collected. The depth, for example, varied from 1.85 to 2.7 in standard length in 44 specimens measured. The opercular flap in several rather large specimens was notably produced, approaching, in that respect, the long-eared sunfish (*megalotis*). However, they have the longer gill rakers and the long, pointed pectorals of the bluegill. It so happens that these particular specimens were taken in a comparatively small body of water where both species occurred. Hubbs (1926, p. 71) has reported a number of combinations of hybrids. It is possible, although not probable, that the specimens with the long "ears" are hybrids. Other pronounced variations—as, for example, the differences in the depth of the body and in color—also occur among the specimens at hand, which are difficult to ascribe to the hybridization of local species and appear to be only variations within the species. It seems probable, therefore, that the difference in the development of the opercular flap, too, constitutes a variation within the species.

The marked variation in appearance among fish of this species may be said to be reflected in their feeding habits, as a wider range of diet appears to exist than for any of the other members of this family. According to the contents of 42 stomachs examined, this species utilizes considerable vegetation and appears to take much of its food from the substratum, but also feeds at the surface and among the plants. Filamentous algae probably composed fully 50 per cent of the ingested material, appearing far too frequently to have been taken incidentally in the capture of other food. Quantities of pond snails, which seemed to be somewhat neglected by the other fish of the region, also had been taken. May-fly nymphs, midge larvae, and a variety of other insects were commonly present in the stomachs. Minnows appear to be taken rarely, even by the full-grown bluegill, as only a single *Gambusia* was found among the 42 fish examined. The intestine was found to vary from 60 to 78 per cent of the total length of the fish.

This species appears to be the most prolific member of the sunfish family, as a female of 155 millimeters contained fully 12,000 eggs. It is said to be one of the most productive species and is recommended as being of considerable value for pondfish culture. The female appears to attain sexual maturity at an approximate total length of 90 millimeters. The spawning season evidently is an extended one, probably reaching its height during the early summer. Forbes and Richardson (1908, p. 259) report ripe fish for Illinois in May and June. No specimens taken in May are at hand. Fish with well-developed gonads, however, were taken in June, July, and August. Two hundred specimens, ranging in length from 14 to 172 millimeters ( $1\frac{1}{2}$  to  $6\frac{3}{4}$  inches), were collected at the following localities: Borrow pits, Grenada Road; slough at Browning; slough at Money; Hadley or Allen Lake; and Roebuck Lake.

### 36. *Lepomis megalotis* (Rafinesque)

LONG-EARED SUNFISH; "BLUE-NOSE SUNFISH"; "NIGGER BREAM"

*Ichtheüs megalotis* Rafinesque, Ichthyologia Ohiensis, 1820, p. 29.

This beautiful sunfish is not especially numerous locally. Adult males (120 millimeters long) are remarkable on account of a large nuchal hump. The species is recognized by the long, black, opercular flap, the moderate number (37 to 39) of scales in a lateral series, and the few (6) very short gill rakers on the first arch. Published accounts state that this species has no black spot at base of last rays of dorsal. Some of the specimens in the present collection, however, have an indication of such a spot.

The long-eared sunfish at Greenwood was found only in deep, clear waters, although at Augusta, Ga. (Hildebrand, 1923, p. 6), it occurred in densely overgrown brickyard ponds and also in certain borrow pits along the levee of the Savannah River. Its form does not indicate an especially active fish.

Midge larvæ constituted the bulk of the food found in eight specimens examined. The larvæ were supplemented by water boatmen (*Corixa*), with a small quantity of miscellaneous material. The intestine is equal to one-half the total length of the fish.

Spawning fish were taken in August and September. The eggs appear to be less numerous but of larger size than those of the other members of this family. A female 93 millimeters long contained approximately 1,000 nearly mature eggs that exceeded 1 millimeter in diameter. The sexes are readily distinguished in mature fish by the nuchal hump in the male.

Eleven specimens, ranging from 62 to 122 millimeters ( $2\frac{1}{2}$  to  $4\frac{1}{8}$  inches) in total length, were collected from an artesian well overflow and a slough at Browning and from Roebuck Lake.

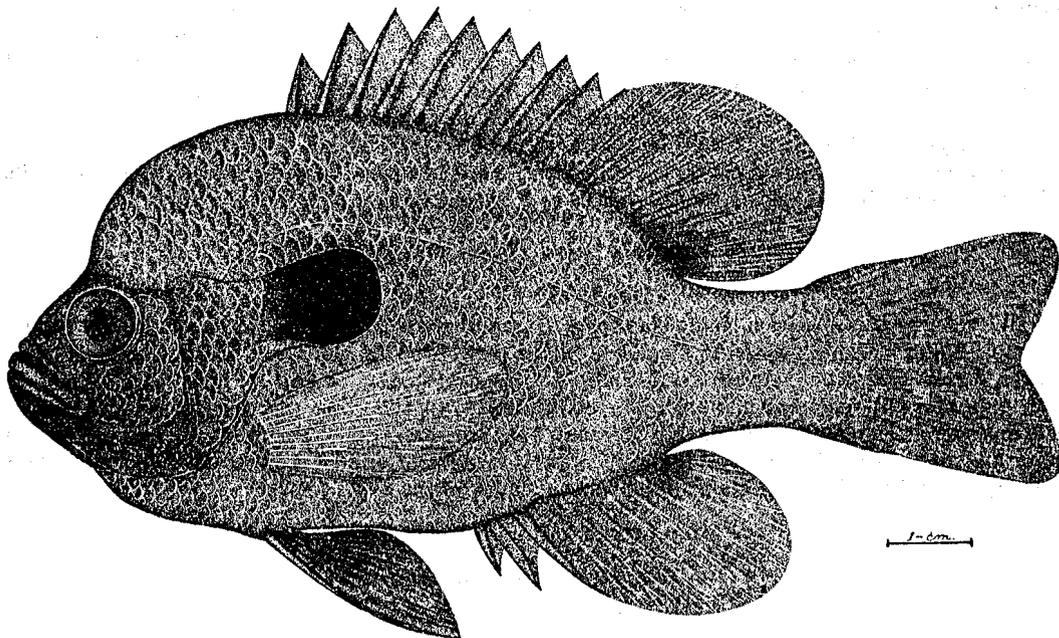


FIG. 9.—*Lepomis megalotis* (male)

### 37. *Lepomis symmetricus* Forbes

#### SYMMETRICAL SUNFISH

*Lepomis symmetricus* Forbes, in Jordan and Gilbert, Bull., U. S. Nat. Mus., XVI, 1883, p. 473.

We refer two small specimens, 51 and 56 millimeters (2 and  $2\frac{1}{8}$  inches) in length, to this species, both taken in a borrow pit on the Itta Bena Road. The fish probably is rare locally. This species appears to be characterized by the symmetrical body, both the dorsal and ventral outlines being about equally curved. Other distinctive characters are the rather long gill rakers, which are about nine in number and about half the length of the eye; the incomplete lateral line, with several pores missing on the arched portion, interrupted posteriorly and resumed on middle of side of caudal peduncle; the moderately long, pointed pectoral fins, reaching slightly beyond origin of anal; and the characteristic vertically elongate dark spots on the base of some of the scales (described in Forbes's original description as "vertical dark bars"). The specimens at hand have the caudal fin distinctly emarginate, as originally described by Forbes, not round, as shown in a drawing published by Evermann and Kendall (1894, Pl. XXXII, fig. 2) and republished by Jordan and Evermann (1896-1900, Pl. CLIX, fig. 424), based on a fish caught in Texas. The dorsal has X, 10 rays; anal III, 10; scales 33.

Immature insects, consisting of dragon-fly nymphs and midge larvæ, had been ingested by these fish. The length of the intestine is slightly over one-half the total length of the fish.

### 38. *Lepomis humilis* (Girard)

#### ORANGE-SPOTTED SUNFISH

*Bryllus humilis* Girard, Proc., Ac. Nat. Sci., Phila., 1857, p. 201.

The orange-spotted sunfish is one of the most brilliantly colored of our fresh-water fishes. It is so small in size that it has no commercial value, rarely exceeding a length of  $3\frac{1}{2}$  inches. It was not taken very often, and it does not seem to be very numerous locally, although it may have been overlooked at times because of its diminutive size.

An examination of the stomach contents of 15 individuals indicated a varied animal diet, consisting of the water boatman *Corixa*, midge larvæ, minnows, and minor quantities of miscellaneous materials. The intestine is from 43 to 45 per cent of the total length of the fish.

The season of reproduction evidently is an extended one, as ripe fish were found from June to September. They were less frequent, however, toward the latter part of this period. A fish of 60 millimeters contained 1,200 nearly ripe eggs, which was probably above the average, for two others of approximately the same length had only about one-half as many.

Twenty-four of these fish were collected, ranging in total length from 58 to 75 millimeters ( $2\frac{1}{4}$  to 3 inches). A borrow pit on the Itta Bena Road furnished most of these specimens, while others are from a borrow pit at Money and from Roebuck Lake.

### 39. *Lepomis heros* (Baird and Girard)

*Pomotis heros* Baird and Girard, Proc., Ac. Nat. Sci., Phila., 1854, p. 26.

We refer to this species a single specimen, 70 millimeters ( $2\frac{5}{8}$  inches) in length, taken from a bayou at Sidon. The specimen in alcohol is rather plain brownish in color; base of scales slightly lighter, forming faint pale stripes along the rows of scales; opercular spot on bony part of opercle, with pale margin; pectoral fins are plain translucent; all the other fins are dusky with broad, pale margins. Dorsal formula is X, 11; anal III, 10; scales 37. The pectoral fins are rather short and not very pointed, reaching only opposite origin of anal, 1.4 in head. The gill rakers are very short, equaling only about one-fifth the length of the eye.

### 40. *Micropterus salmoides* (Lacépède)

#### LARGEMOUTH BLACK BASS

*Labrus salmoides* Lacépède, Hist. Nat. Poiss., IV, 1802, p. 716.

This bass is represented by 16 specimens, ranging from 30 to 400 millimeters ( $1\frac{1}{8}$  to  $15\frac{3}{4}$  inches) in length, all taken in a borrow pit containing a profuse growth of the primrose willow on the Greenwood-Itta Bena Road. The species does not appear to be abundant locally, and its congener, the small-mouth bass, was not seen. Its absence from the collection has little significance, however, as collecting operations were confined very largely to sluggish and standing water, an environment not frequented by the smallmouth bass.

An examination of the ingested material of 16 individuals showed a predominance of fish, supplemented by insects. *Gambusia* was preyed upon almost to the exclusion of other fish, probably because of its abundance in the particular pond where the bass were taken and because of its unwary disposition. *Fundulus kompi*, which simulates *Gambusia* in size and abounds in the pond where the bass were taken, had not been utilized. Six out of nine young bass, ranging in length from 30 to 47 millimeters, had eaten *Gambusia*, with May-fly nymphs, midge larvæ, and immature dragon flies less in evidence. The mature bass had taken aquatic beetles and crustaceans in addition to minnows.

Spawning is reported to take place in May and June in Illinois (Forbes and Richardson, 1908, p. 269). Seven adults collected early in June had passed the reproductive period.

41. *Elassoma zonatum* Jordan

## PIGMY SUNFISH

*Elassoma zonatum* Jordan, Bull., U. S. Nat. Mus., X, 1877, p. 50.

A single specimen, 26 millimeters (1 inch) in length, occurs in the collection, and it is the only pigmy sunfish that was seen, although repeated attempts were made to capture more specimens in the overflow from an artesian well where this one was caught. The specimen was taken with a dipnet in company with *Gambusia*, in clear, closely shaded, and relatively cold shallow water. The environment in which this fish usually is taken is favorable to mosquito breeding, and the fact that the individual at hand, when placed in an aquarium, readily fed on mosquito larvæ suggests that the species may be of value in localities where it is abundant in eradicating mosquito larvæ. Limited observations made by the senior author at Augusta, Ga., did not prove this to be the case, however, for he found relatively prolific breeding in a swamp well stocked with this fish, where, upon introducing *Gambusia*, mosquito production virtually ceased. It is entirely impossible, however, to know what the situation would have been in this swamp if the pigmy sunfish had not been present. Nevertheless, the fish may have taken a fair toll of "Wigglers."

Four pigmy sunfish collected at Augusta, Ga., had ingested the minute crustacean Cladocera and ostracods, with midge larvæ and insect fragments in about equal amounts. The intestinal tract equaled one-half the length of the fish, which ranged from 24 to 26 millimeters in total length.

42. *Morone interrupta* Gill

## YELLOW BASS

*Morone interrupta* Gill, Proc., Ac. Nat. Sci., Phila., 1860, p. 118.

A single yellow bass, 168 millimeters ( $6\frac{3}{8}$  inches) in length, was caught. This fish was seined in Roebuck Lake. It is reported in current works to be primarily a fish of the larger rivers and lakes. The species quite certainly does not occur in the smaller ponds and bayous locally.

Forbes and Richardson (1908, p. 322) report that "what little is known of its food indicates an insectivorous habit, adults feeding on aquatic larvæ, especially those of May flies, together with small crustaceans and terrestrial insects." The stomach of the specimen at hand contained portions of a small fish, a back swimmer, and a few plant fragments.

43. *Aplodinotus grunniens* Rafinesque

## "GASPERGOU"; FRESH-WATER DRUM; SHEEPSHEAD

*Aplodinotus grunniens* Rafinesque, Journal Physique, 1819, p. 88.

This rather generally distributed species of the Mississippi Valley is represented by 14 specimens, ranging in length from 225 to 370 millimeters ( $8\frac{3}{8}$  to  $14\frac{1}{4}$  inches), and was taken only in a slough near Lake McIntire and in Roebuck Lake.

The gaspergou has a somewhat varied diet. According to the contents of 12 stomachs examined, it utilizes fish, mollusks, and insects in about equal amounts, with a minor quantity of miscellaneous materials, including vegetation and minute crustaceans. Vegetation, however, was present in only two stomachs and may have been taken incidentally in the capture of other foods. The intestine is that of a carnivorous fish, being only one-half as long as the fish.

In Illinois spawning is reported to take place during May and June (Forbes and Richardson, 1908, p. 325). Our specimens, taken during the summer, had the sexual organs in a collapsed condition.

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